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Cognitions, Emotions, and Behaviours Concerning Comorbid Obesity in Psoriasis

Pavlova, Neli

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King's College London

Institute of Psychiatry, Psychology & Neuroscience

Health Psychology Section

Cognitions, Emotions, and Behaviours Concerning Comorbid Obesity in

Psoriasis

By

Neli Pavlova

This thesis incorporating publications submitted for the degree of

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Abstract

Psoriasis is a chronic inflammatory skin condition that affects 2-9% of the world's population. The well-being of people living with psoriasis is often greatly compromised due to the physical and psychological impact of the skin condition. It is estimated that a third of people living with psoriasis have comorbid obesity which is much more common among them (30-40%) than in the general population (15-20%). Obesity is more prevalent in people with severe psoriasis than those with mild disease and has been linked to sub-optimal treatment response. Both psoriasis and obesity frequently co-occur with depression and anxiety in a bi-directional way, where obesity may drive mental health issues and vice versa. In light of the relationship between psoriasis and obesity, obesity management is a potentially important adjuvant to current psoriasis standard care. However, little is known about the factors that may influence successful weight loss in the context of obesity and psoriasis. Using mixed methods, this thesis aimed to identify the cognitive, emotional, and behavioural factors that are associated with body weight in psoriasis. Such findings would inform future tailored intervention approaches for weight loss that address the idiosyncratic challenges of people living with psoriasis.

A systematic review of the psychosocial factors associated with body weight in psoriasis found that obesity (assessed as Body Mass Index (BMI) of ≥ 30 kg/m²) is weakly if at all associated with depression and anxiety based on exclusively cross-sectional evidence (N=16). The review highlighted the need to longitudinally explore the association between depression and anxiety with body weight in psoriasis, ideally using more accurate indicators of body fat mass such as waist circumference and controlling for important confounders, consistently overlooked by previous studies. To address these identified gaps in existing evidence, cross-sectional and longitudinal analyses were conducted using routine patient data (N= 326 and

N=191, respectively) and waist circumference as an additional outcome to BMI. Through these analyses, the association between depression and anxiety with waist circumference and BMI were evaluated, while controlling for demographic (e.g., age and gender) and illness-related confounders (e.g., treatment type, number of comorbidities, and psoriasis severity). These analyses revealed that depression and anxiety have a small contribution to body weight in psoriasis, whereas psoriasis illness severity and multimorbidity were significantly positively associated with both waist circumference and BMI. Therefore, addressing mood alone is unlikely to be sufficient for weight loss among people living with psoriasis. As raised above, the systematic review also emphasised the stark unavailability of studies looking at the role of other psychosocial such as cognitions related to body weight and psoriasis. Behavioural factors, including coping behaviours like emotional eating in relation to body weight outcomes, are also overlooked by existing evidence. These factors may be particularly central here, beyond the role of depression and anxiety.

As such and given that qualitative studies focused on weight loss in psoriasis have not been conducted, as shown by the review, a qualitative study was deemed necessary to explore in more depth and through a person-centred approach, cognitions, emotions, and behaviours related to weight loss in psoriasis. Semi-structured interviews were conducted with people living with psoriasis and comorbid obesity (N= 24). Participants expressed their feelings of powerlessness in the face of psoriasis and highlighted their lack of clarity regarding the link between psoriasis and obesity. Emotional eating was perceived as a way to cope with the psoriasis burden and associated negative emotions. These findings accentuated the role of illness perceptions and emotional eating in body weight in psoriasis, factors consistently overlooked by quantitative studies in this patient population. Informed by the qualitative study, a cross-sectional study was conducted (N=167) to evaluate the role of illness

perceptions and emotional eating in relation to BMI and waist circumference in psoriasis, while controlling for important demographic, lifestyle, and illness-related confounders. Illness perceptions (viewing psoriasis as chronic and treating high body weight and psoriasis as two separate conditions) and emotional eating were positively associated with higher waist circumference and BMI, after controlling for confounders. Similarly to previously described analyses, depression and anxiety were not significantly associated with waist circumference or BMI. These findings corroborate the important role of cognitions and behaviours observed in the qualitative study and the likely complex interplay between cognitions and behaviours related to obesity and psoriasis.

Findings from all these studies suggested that a tailored weight loss intervention for people living with psoriasis should consider the key role of illness perceptions and emotional eating in relation to body weight. Unlike existing weight loss interventions that draw on standard approaches developed for people without comorbid physical health conditions, in the context of psoriasis, a weight loss intervention should consider psoriasis-specific challenges related to body weight, likely leading to more optimal weight-related outcomes.

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Abbreviations

ANOVA	Analysis Of Variance
APA	American Psychiatric Association
ART	Affect Regulation Theory
BMI	Body Mass Index
BSA	Body Surface Area
CTT	Classical Test Theory
CSM-SR	Common Sense Model of Self-Regulation
CI	Confidence Intervals
CFA	Confirmatory Factor Analysis
DDRMQ	Diabetes and Depression Representation and Management Questionnaire
DEBQ	Dutch Eating Behaviour Questionnaire
DLQI	Dermatology Quality Of Life Index
ET	Escape Theory
GAD	Generalised Anxiety Disorder
ICD-10	International Classification of Diseases, 10 th Edition
IPQ	Illness Perception Questionnaire
IPQ-R	Illness Perception Questionnaire Revised
MDD	Major Depressive Disorder
MI	Motivational interviewing
NHS	National Health Services
NICE	National Institute of Health and Care Excellence
OR	Odd Ratios
PASI	Psoriasis Area Severity Index
PGA	Physician Global Assessment
PHQ	Patient Health Questionnaire
PRO	Patient-reported outcomes
PsA	Psoriatic Arthritis
PsoWell program	Psoriasis and Wellbeing (PsoWell) program
QoL	Quality of Life
RCT	Randomised Controlled Trial
RR	Risk ratios
TNF	Tumour Necrosis Factor
UK	United Kingdom
SD	Standard Deviation

Introduction to the thesis

The initial objective of this thesis was to design a behaviour change weight loss intervention for people living with psoriasis and comorbid obesity which can be implemented within a multidisciplinary team. Several factors influenced the decision to change the objective to investigating the cognitive, emotional, and behavioural factors concerning comorbid obesity in psoriasis. First, the scarcity of the studies looking into the broad psychosocial factors that may play a role in obesity and psoriasis, identified by the systematic review, urged the need to conduct qualitative and quantitative research to provide a better understanding of the factors that may be potentially implemented in a behaviour change weight loss intervention. Second, this thesis was completed during the COVID-19 pandemic. In line with the restrictions, the conducted research could not be done through clinical settings; an intention that was initially set up during the planning phase of the thesis. The recruitment for the conducted studies within this thesis had to take place online, despite obtaining an NHS ethical approval; factors that limited the opportunity to design and test an intervention within multidisciplinary settings. Despite that, these challenges were acknowledged and successfully addressed in the design of the conducted studies. In total, four studies were conducted, two quantitative and one qualitative. Each completed study informed the formulation of the objectives for the subsequent one, as outlines below. Together the findings from the conducted studies can be used to inform future behaviour change weight loss intervention for people with psoriasis. The main research questions which this thesis aimed to address were:

1. Which psychosocial factors are associated with obesity in psoriasis?
2. Are depression and anxiety associated with obesity in psoriasis cross-sectionally and over 12 months follow-up when controlling for important demographic and illness-related factors?

3. What are the beliefs and perceptions related to weight-loss in people living with obesity and psoriasis?
4. What are the cognitive, emotional, and behavioural factors that are associated with body weight in people living with psoriasis?

A systematic review (Study 1) was carried out to synthesise evidence on the association between obesity and psychological and social factors in psoriasis, and to inform future directions in this research area. The findings of the systematic review demonstrated that little research is available on the role of psychosocial factors that are related to obesity in psoriasis. The studies identified: (1) were not informed by theory, (2) mostly cross-sectional, (3) were focused mainly on depression and anxiety despite their mixed association with BMI, (4) failed to consider the role of illness-related (e.g., psoriasis severity) and demographic (e.g., gender) factors that may impact on the association between psychosocial factors and obesity in psoriasis, and (5) used BMI as the only weight related outcome which may potentially obscure the association with psychosocial factors due to the lack of preciseness of this body weight measure (further details are available in Chapter two). This systematic review is published in the journal of *Skin Health and Disease*¹ and is presented in Chapter three.

In consideration of these identified knowledge gaps by the review, a longitudinal analysis of an existing clinical dataset (Study 2) was carried out to explore the association between depression and anxiety with body weight at 12 months follow-up from baseline, accounting for demographic and illness-related factors in people living with psoriasis, and using waist

¹ All citations within published articles have been converted to APA 6th referencing style and are included in the final reference section of this thesis.

circumference in addition to BMI. The use of real-world data may be reflecting the actual clinical aspects with highest importance that may be overlooked in RCT (Kim, Lee, & Kim, 2018). Cross-sectional analyses were also included within this study to explore if the level of association between depression and anxiety with weight-related outcomes, as demonstrated in the systematic review, remained when accounting for demographic and illness-related factors. Interestingly, the cross-sectional and longitudinal analysis were consistent with most of the studies in the systematic review which reported that depression and anxiety have a small contribution to body weight in psoriasis. These findings suggest that addressing mood alone is unlikely to be sufficient for weight loss among people living with psoriasis. Illness-related factors, including psoriasis illness severity and multimorbidity, emerged as more important factors in the association with both waist circumference and BMI in psoriasis. Together these findings suggest that (1) there may be additional psychosocial factors, beyond depression and anxiety, that better explain the presence of high rates of obesity in psoriasis and (2) a qualitative approach may be helpful to better understand the broader psychosocial factors that may relate to obesity in psoriasis. This study is published in the journal of *Skin and Health Disease* and is presented in Chapter six.

Next, a qualitative study (Study 3) exploring the beliefs and perceptions related to weight-loss in people with psoriasis was conducted. The use of qualitative methods provides a better understanding of a complex phenomenon which is particularly needed given the limited evidence of the factors that may be associated with body weight and psoriasis. This study highlighted that there are complex psoriasis-related cognitive and behavioural factors that may contribute to weight gain or challenge weight loss which warrant further investigation. Most participants viewed psoriasis as unrelated to obesity. A well-controlled psoriasis and improvements in psoriasis symptoms were considered as major motivators for engaging in a

weight loss program by individuals who viewed psoriasis and obesity as related conditions. Comfort eating was perceived as an escape strategy from the psoriasis-induced negative emotions. Participants shared their dissatisfaction with current weight loss recommendations which were perceived as too generic. Participants suggested that a desirable weight loss program would require both emotional and behavioural support, with an emphasis on psoriasis's burden. This qualitative study is published in the *British Journal of Health Psychology* and is presented in Chapter seven.

Based on the findings of the qualitative study, a cross-sectional study was subsequently conducted (Study 4) to build up on the previously gathered qualitative evidence and to investigate potential associations between cognitive, emotional, and behavioural factors that emerged from the qualitative explorations with body weight in psoriasis. Findings suggested that emotional eating was associated with both BMI and waist circumference. Illness perceptions (beliefs that psoriasis is a chronic condition self-managing psoriasis and high body weight as separate conditions) were positively associated with BMI only. The lack of association between depression or anxiety with body weight outcomes was observed again. Together these findings indicated the potential key role of illness perceptions and emotional eating in relation to body weight in psoriasis that require further investigation in robustly conducted RCTs. This cross-sectional study is in submission for consideration for publication in the *Psychology & Health* journal and is presented in Chapter eight.

Chapter 1: Introduction to Psoriasis

1.1. Chapter overview

This chapter will introduce chronic plaque psoriasis in terms of its clinical features, physical burden, and psychosocial consequences. The clinical features of psoriasis will be discussed with references to its clinical presentation, pathophysiology and symptoms, epidemiology, and disease severity measures. This will be followed by a summary of the common psoriasis comorbidities, both physical and psychological. The emphasis here will be on comorbid obesity and its anticipated physical and psychological consequences in the context of psoriasis, drawing from the evidence in the general literature. The chapter will conclude with a review of the current psoriasis treatment approaches, arguing that these have not necessarily acknowledged the comorbid physical burden of obesity and the idiosyncratic psychological challenges that people with psoriasis may face.

1.2. Pathophysiology and clinical presentation of chronic plaque psoriasis

Chronic plaque psoriasis is a debilitating systemic inflammatory disease that affects the skin and joints (Badri, Kumar, & Oakley, 2017; Griffiths, Armstrong, Gudjonsson, & Barker, 2021). The most common clinical phenotype of psoriasis is chronic plaque or psoriasis vulgaris, accounting for 90% of the cases and characterised with the appearance of psoriasis plaques (Griffiths et al., 2021; Griffiths & Barker, 2007). Other less common phenotypes include guttate, erythrodermic and pustular psoriasis. This thesis focuses specially on chronic plaque psoriasis, termed psoriasis across the discussions.

Psoriasis is largely immune-mediated disease, which manifests in individuals carrying one or more psoriasis susceptibility genes and after their exposure to certain environmental triggers (Griffiths & Barker, 2007; Nestle, 2009; Villanova et al., 2014). Heritability is considered as

the main risk factor for developing psoriasis (Griffiths, Armstong, Gudjonsson, & Barker, 2021), with HLA-C*06:02 known as the most important genetic risk factor (Strange et al., 2010). Stress, infections (especially streptococcal), alcohol consumption, smoking, exposure to medicines such as lithium, antimalarials, and nonsteroidal anti-inflammatory agents are all environmental triggers that may increase the risk of psoriasis onset (Nestle, 2009; Villanova et al., 2014). Being overweight or obese are both risk factors for psoriasis onset (Armstrong, Harskamp, & Armstrong, 2012; Budu-Aggrey et al., 2019), as well as a probable side effect of having psoriasis (Kumar, Han, Li, & Qureshi, 2013). Chapter two provides a more detailed overview of the link between increased body weight and psoriasis.

The interaction between genetic and environmental factors that may trigger psoriasis lead to the development of persistent inflammation, which results in uncontrolled keratinocyte growth and defective differentiation of the skin cells. The activation of keratinocytes and immune cells causes the hyperproliferation of keratinocytes – skin cells that are located in the top layer of the skin (epidermis) and involved in the formation of the psoriasis plaque (Grän, Kerstan, Serfling, Goebeler, & Muhammad, 2020). In healthy skin, it takes 28 days for the keratinocytes to move from the bottom to the top of the epidermis where they gradually flatten and die off. In psoriasis, this process is speeded up and takes between six to eight days (Halprin, 1972). This leads to the abnormal overproduction of skin cells that have not had enough time to fully develop and appear ‘sticky’, forming the psoriatic plaque. These plaques contain (1) many inflammatory cells making them thicker and (2) elevated levels of large blood vessels, leaving the skin pink or red in appearance. The classic morphology of psoriasis is that of well demarcated, salmon-pink plaques covered in silvery scales on white skin, and grey or silvery in colour plaques on black skin. The plaques can have variable sizes and thickness – they may be thick, thin, large or small (Griffiths & Barker, 2007). Plaques are

most active at the edge: rapidly progressing lesions may be annular, with normal skin in the centre (Griffiths et al., 2021). Plaques are usually distributed symmetrically, and occur most commonly on the exterior aspects of elbows and knees; scalp (where they rarely encroach beyond the hairline); lumbosacral region and umbilicus (Griffiths & Barker, 2007). Psoriasis plaques can range in severity from localised small patches to full body coverage and are associated with variety of clinical symptoms such as bleeding, pain, dryness, and itchiness (Globe, Bayliss, & Harrison, 2009; Rendon & Schäkel, 2019).

1.3. Clinical symptomatology and epidemiology of chronic plaque psoriasis

1.3.1. Clinical symptomatology

Psoriasis symptoms may range from periods of complete clearance to relapse, in a cyclical way such as symptoms may get worse for a while, then eventually get better, or even disappear completely for shorter or longer periods of time, and return back again (Naldi & Rzany, 2009). Periods of serious or active symptoms are called ‘flare-ups’, whereas periods of complete clearance are called ‘remission’.

A variety of physical signs and symptoms are used to evaluate psoriasis disease severity and remission. These include erythema (redness of the skin), induration (thickness of the skin), and desquamation (peeling skin) that may cause itchiness (also known as pruritus), bleeding, pain, dryness and burning of the skin (Weisman, Pollack, & Gottschalk, 2003; Globe et al., 2009). Itch affects between 60-96% of people living with psoriasis and it is the primary source of psoriasis discomfort, embarrassment and distress (Strober et al., 2019). It is viewed by patients and clinicians as the most important factor contributing to disease severity (Lebwohl et al., 2014; Van De Kerkhof et al., 2015).

The clinical symptoms may extend beyond the skin and affect the joints. Approximately 20% of patients living with psoriasis will develop psoriatic arthritis (PsA) during their life course (Alinaghi et al., 2019). The experienced symptoms burden may vary among patients depending on the involvement of specific body regions that may impact patients differently. For instance, highly visible psoriasis plaques such as on the face and/or the presence of comorbid PsA may inflict a greater burden (Augustin et al., 2019; Egeberg, See, Garrelts, & Burge, 2020; Griffiths et al., 2018). This indicates that people living with psoriasis may present a heterogeneous population with individualized disease expressions.

1.3.2. Epidemiology

Accurate findings for the prevalence of psoriasis are difficult to obtain due to the lack of a validated diagnostic criterion and the different case definitions (self-reported versus physician's diagnosis) across the studies (Griffiths & Barker, 2007). Important factors in the variation of the prevalence of psoriasis include age, gender, geography, and ethnicity, likely due to genetic and environmental factors (Parisi et al., 2020). The prevalence rates appear to depend on the distance from the equator. Populations located closer to the equator (e.g., Egypt, Tanzania, Sri Lanka, Taiwan) have lower rates of psoriasis than countries more distant from it (e.g., Europe and Australia) (Parisi et al., 2020). Higher prevalence rates are reported in Caucasians compared with other ethnic groups (Farber, 1998). Furthermore, characteristics of psoriasis such as its remitting–relapsing course, diversity of clinical presentations, and heterogeneity in severity may influence the vast difference in prevalence estimates (Griffiths & Barker, 2007; Griffiths et al., 2018). Aspects of the research design and methodology may also be significant. Different definitions of prevalence, case definitions, sample frames and procedures, and age groups studied are all examples of this (Gelfand et al., 2005).

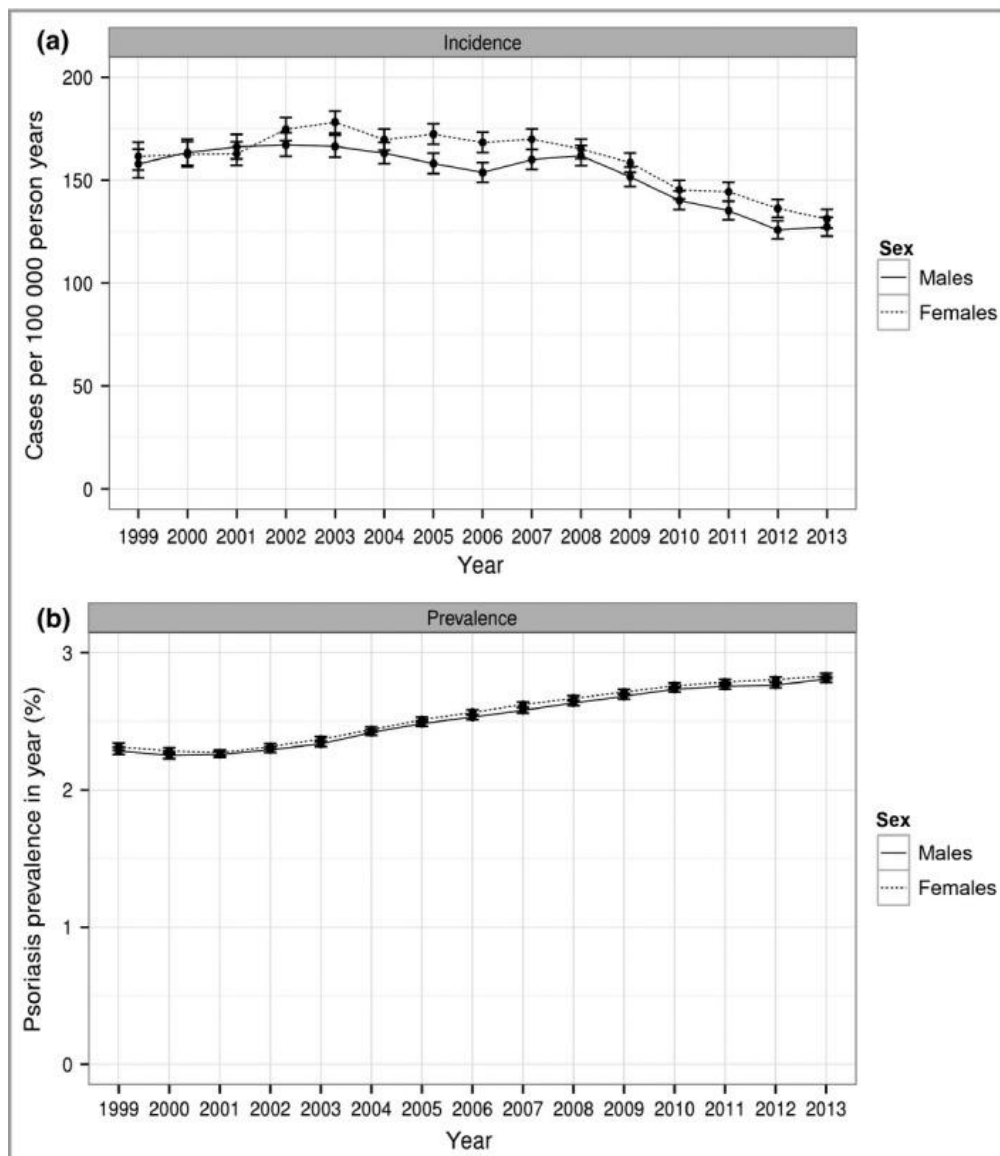
Despite these limitations, several variations in the prevalence of psoriasis have been documented and it is estimated to affect between 2-4% of the population in western countries (Parisi et al., 2020). North- and South- Eastern Europe have substantially higher rates than the United Kingdom. Physician-diagnosed psoriasis is estimated to affect roughly 6% of the population in Denmark (Egeberg, Andersen, & Thyssen, 2019), 8.5% in Norway (Bø, Thoresen, & Dalgard, 2008), 2%-3% in Italy (Prignano et al., 2018), and 1.3% in France (Grodner, Sbidian, Weill, & Mezzarobba, 2021). In Australia, psoriasis is thought to range from 2% to nearly 7% (Kilkenny, Stathakis, Jolley, & Marks, 1998; Plunkett et al., 1999; Quirk, 1979). Whereas in the United States, the estimated rates are similar to those in the United Kingdom, reaching around 2% of the population (Kurd & Gelfand, 2009; Stern, Nijsten, Feldman, Margolis, & Rolstad, 2004). In Europe, however, research based on self-reported diagnoses appeared to have higher prevalence rates than research based on physician diagnoses (Parisi, Symmons, Griffiths, & Ashcroft, 2013). As a result, the identified geographic variations could be attributable to the psoriasis case definition and not necessarily because of geographical variations in prevalence and incidence.

1.3.3. Incidence in the United Kingdom (UK)

In Europe, the United Kingdom (UK) has one of the lowest rates of psoriasis, estimated to affect between 1.3- 2.2% of the population (Smith & Barker, 2006). This trend may be because high income countries such as the UK may have more optimal preventive strategies in place that increase disease awareness which, in turn, decrease the risk of psoriasis onset (Witter, Sheikh, & Schleiff, 2022). Adjusted psoriasis incidence declined from 159 cases per 100,000 person years (95% CI 155-164) in 1999 to 129 per 100 000 person years (95% CI 126-133) in 2013, with greatest decline observed after 2008. Conversely, psoriasis prevalence rates increased from 2.3% (2297 cases per 100 000 person years) in 1999 to 2.8% (2815 per

100 000 person years) in 2013. Figure 1 summarises the prevalence and incidence of psoriasis over time for both males and females, adjusted for year and sex, indicating men and women as being equally affected (National Institute of Clinical Excellence (NICE), 2014).

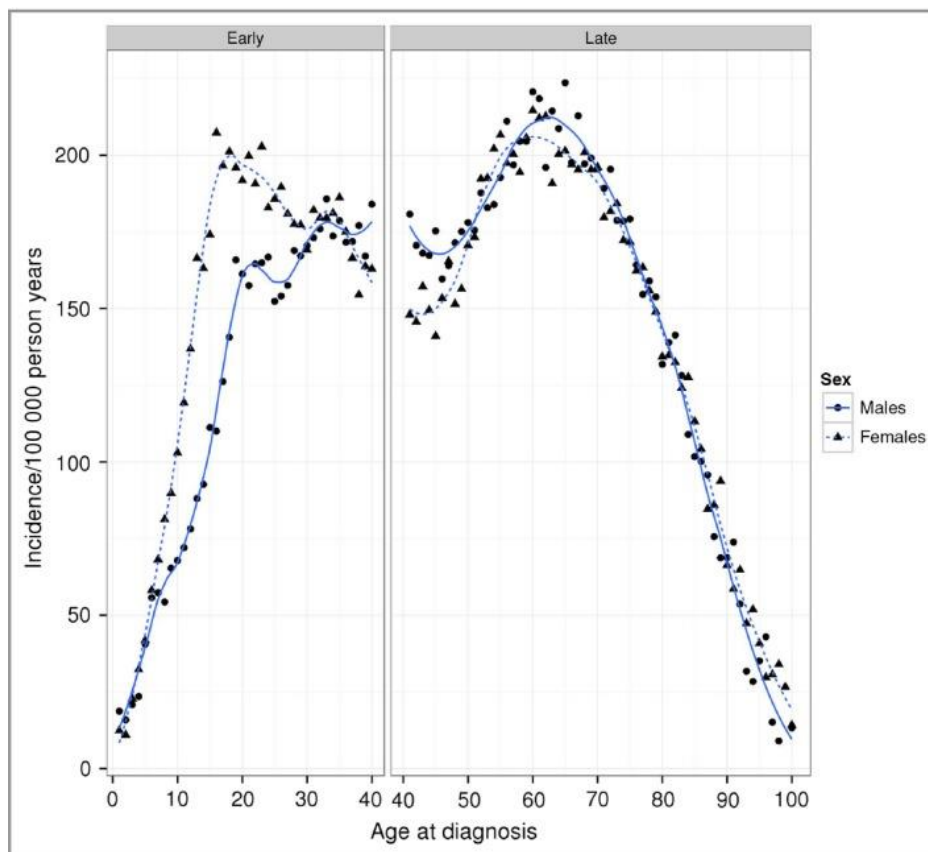
Figure 1. (a) Incidence and (b) prevalence of psoriasis from 1999 to 2013 for both males and females



Note: Source NICE (2014), p. 12. Findings are presented as 95% confidence intervals.

Psoriasis can occur at any age, although it is uncommon in children (0.71%) and in the most cases occurs before 35 years of age (NICE, 2014). Psoriasis incidence plotted against age showed a strongly bimodal pattern (Figure 2). ‘Late-onset’ psoriasis, categorised as being diagnosed later than 40 years of age shows little difference in distribution between males and females. However, ‘early-onset’ psoriasis, characterised as being diagnosed earlier or at 40 years of age, showed clear difference with females being more likely to be diagnosed at an earlier age (Springate et al., 2017).

Figure 2. *Incidence of psoriasis by age at diagnosis for males and females*



Note: Graph with Loess smoothers (males, solid line; females, dashed line). The graph has been split into panels for early- and late-onset psoriasis (NICE, 2014, p.23)

The latitude differences in both incidence and prevalence of psoriasis have been showed in the UK (Springate et al., 2017). Psoriasis incidence increased by 6.5 cases per 100,000 for every degree increase in latitude (95% CI 4-9.1 cases per 100 000) and prevalence increased by 201 cases per 100 000 for every degree in latitude (95% CI 163.5-238.6 per 100 000), controlling for year and deprivation status. In Southwest England, mean psoriasis incidence was 144 (95% CI 138–150 cases per 100 000) and mean prevalence was 2323 (95% CI 2266–2380 cases per 100 000). In Scotland, mean psoriasis incidence was 174 (95% CI 167–181 cases per 100 000) and mean prevalence was 3060 (95% CI 2991–3128 cases per 100 000) (Springate et al., 2017).

1.4. Psoriasis disease severity classification and measures

In both clinical practice and research, psoriasis severity is categorized as either ‘mild’ or ‘moderate-to-severe’ which is guided by objective assessments for measuring psoriasis severity such as Body Surface Area (BSA), Physician’s Global Assessment (PGA), and the Psoriasis Area and Severity Index (PASI) (Langley & Ellis, 2004). These objective measures may underestimate disease severity. Even if lower degrees of skin involvement are recorded (e.g., BSA < 10% indicative of mild disease), the involvement of visible areas such as face, palms, soles, genitalia) may compromise quality of life. Hence, it is often suggested that dermatologists should consider the location of the psoriasis plaques (Knuckles, Levi, & Soung, 2018; Menter et al., 2009) and quality of life (e.g., using the Dermatology Quality of Life, DLQI) (Finlay & Khan, 1994) to more fully and accurately assess psoriasis severity.

1.4.1. Disease severity classification methods

A recent Delphi consensus recategorized the psoriasis severity from mild, moderate, and severe in favour of a dichotomous definition of psoriasis severity: (i) mild and (ii) moderate-

to-severe (Strober et al., 2020). This recategorization was guided by the idea that there is lack of consideration for the impact of psoriasis plaques on more visible areas or past treatment history which may lead to mis-categorisation and undertreatment. This approach was taken in line with consensus that systemic therapies generally indicate more severe disease (Cohen et al., 2020) requiring more intensive treatment compared to topicals (Strober et al., 2020).

Patients who are considered as candidates for topical therapy are categorized as having mild psoriasis (less than 3% of BSA) (Strober et al., 2020). Whereas those who meet one at least one of the following criteria: (i) BSA >10%, (ii) psoriasis plaques appearing on visible areas, and (iii) failure of topical therapy are considered as candidates for systemic treatment and categorised as having ‘moderate-to-severe’ psoriasis (Strober et al., 2020).

1.4.2. Psoriasis Area and Severity Index (PASI)

The Psoriasis Area and Severity Index (PASI) was developed to assess the effect of retinoid treatment in chronic plaque psoriasis (Fredriksson & Pettersson, 1978). Both intensity and extent (BSA) of the psoriatic plaques are calculated separately for four anatomical regions (head, trunk, upper and lower extremities) by the physician on a 5-point scale with 0 indicating no involvement, 1 slight, 2 moderate, 3 severe and 4 very severe characteristics.

The percentage of involvement of the four anatomical regions is assigned a numerical value of 0-6 with 0 indicating no involvement, 1 = 1-9%, 2= 10-29%, 3= 30-49%, 4= 50-69%, 5= 70-89%, and 6= 90-100% BSA involvement. When calculating the PASI, the four anatomical regions are evaluated according to their proportion of the whole instrument. The PASI score varies from 0 to 72. Higher scores indicate more severe psoriasis. Table 1 summarises the advantages and disadvantages of PASI. PASI is often combined with other objective disease severity measures such as Body Surface Area (BSA).

Table 1. *Advantages and disadvantages of Psoriasis Area Severity Index (PASI)*

Advantages	Disadvantages
Considered as ‘gold standard’ in clinical trials (Naldi et al., 2003) and the most validated measure of psoriasis severity (Feldman, 2004)	No correlation with quality of life (Francesca Sampogna, Sera, & Abeni, 2004), limiting the accurate predictions of psoriasis severity from patient point of view (Feldman, 2004)
Good correlation with other objective outcome measures (Ashcroft, Li Wan Po, Williams, & Griffiths, 1999; Fleischer, Feldman, & Dekle, 1999; Kirby et al., 2001)	No special consideration of highly visible areas such as face, hands, feet, genitals
The assessment is considered easy to conduct and test-retest variability is less than 2% (Weisman et al., 2003)	

1.4.3. Body Surface Area (BSA)

Several objective assessments incorporate an estimation of the involved body surface area (BSA) (Ashcroft et al., 1999). The BSA is easily evaluated by 'the number of patient's hand areas' affected. For decades, the area of one side of a flat closed hand was counted for 1% of the total BSA (Stern et al., 1986). However, planimetric investigations suggested that one hand represent 0.70 – 0.76 % of the BSA (Long, Finlay, & Averill, 1992). This might be one reason why the affected BSA often overestimate disease severity. High interobserver variability is another important concern (Ramsay & Lawrence, 1991). As a single instrument, BSA is not adequate to define the severity of plaque-type psoriasis, as it does not consider the intensity of the psoriatic lesion. When combined with other disease severity measures such as Physician Global Assessment (PGA), the combined use of PGA x BSA has advantages over PASI for measuring disease severity (Walsh et al., 2018).

1.4.4. Physician Global Assessment (PGA)

The Patient Global Assessment (PGA) is an assessment instrument scored on a scale of 0-5, with 0 representing clear skin, 1 almost clear skin, and 5 representing severe psoriasis (Sterry et al., 2010; Strohal et al., 2013). The PGA can be used to show improvement by a comparison with baseline disease severity (dynamic PGA) or it can be an assessment made at one moment in time (static PGA). The PGA is well correlated with other disease severity measures of psoriasis such as PASI (Gottlieb, Chaudhari, Baker, Perate, & Dooley, 2003) and BSA (Langley & Ellis, 2004). A disadvantage of the instrument is the lack of consensus about the scale definition. For example, a score of '3' can either mean 'mild' or 'moderate' disease, subject to the evaluator perspective (Lebwohl et al., 2003; Weisman et al., 2003). Despite this limitation, PGA is practical to use, however, does not provide an overall measure

of psoriasis severity as it does not explicitly account for BSA involvement (Leonardi et al., 2021). When combining BSA and PGA, limitations of both instruments can be eliminated. For example, a patient with extensive BSA involvement (i.e., 40%) may have the same PGA score as a patient with minimal BSA involvement (i.e., 2% BSA), even if the extent of redness and scaling are the same. Thus, when combined, PGA x BSA provided a more comprehensive disease severity assessment tool (Leonardi et al., 2021).

1.4.5. Dermatology Life Quality Index

The Dermatology Life Quality Index (DLQI) is a widely used, simple and practical dermatology specific quality of life instrument. Patients answer 10 questions considering their QoL during the previous week on a 4-point scale, indicating ‘not at all’, ‘a little’, ‘a lot’, and ‘very much’, respectively (Finlay & Khan, 1994). The total DLQI score represents the sum of the scores for each question and ranges from 0 to 30, with higher scores reflecting worse quality of life. Internal consistency and construct validity of the instrument are strong (Weisman et al., 2003), indicating that the DLQI is an adequate instrument to assess the QoL of patients living with psoriasis (Finlay, Salek, Haney, & Group, 2003). Additional details on the DLQI are provided in Chapter 4 of this thesis.

1.4.6. Integrated measures of disease severity

Despite the wide variety of tools for measuring psoriasis severity, no instrument met all validity criteria (Duffin et al., 2017). The objective measures of psoriasis discussed above may fail to recognise the variability in experiences based on the visibility of psoriasis plaques (Knuckles et al., 2018; Menter et al., 2009). Disease assessments, therefore, need to take into account the location of the psoriasis plaques and patients’ quality of life (e.g., using the DLQI) (Finlay & Khan, 1994) to more fully and accurately assess psoriasis severity.

Comorbid conditions (physical and psychological) may also contribute to greater objective

and subjective disease severity evaluation (Griffiths et al., 2018). Therefore, comorbid conditions should be considered when evaluating disease severity.

1.5. Clinical management

Available treatment options for psoriasis are primarily selected based on disease severity, location of psoriasis plaques, and self-reported quality of life (Armstrong & Read, 2020; Kaushik & Lebwohl, 2019a). The psoriasis treatment pathway includes different types of therapies such as topical treatment, suitable for people with mild disease phenotypes.

Phototherapy is the next line of treatment that is used when topical treatment failed to provide satisfactory symptoms response. Systemic non-biologic treatment is used for people whose psoriasis was not responsive to phototherapy. Systemic biologic treatments are used for people with moderate-to-severe psoriasis who cannot tolerate the side effects of systemic non-biologic treatment, or the treatment response is unsatisfactory. Table 2 provides a summary of the treatment pathways in psoriasis (Smith et al., 2020).

Table 2. *Treatment pathways in chronic plaque psoriasis*

Type of treatment	Suitable for	Example of drugs	Method of applications	Clinical considerations
Topical	Patients with mild psoriasis.	Hydrocortisone creams and ointments such as Cyclocort, Halog, Lidex, and Topicort	On skin application	Topical treatment alone may not provide satisfactory disease control, especially in people with psoriasis that is extensive (e.g., more than 10% of body surface area affected). Can be highly burdensome to patients since regular application is required.
Phototherapy	Plaque psoriasis which cannot be controlled with topical treatment.	UVB light (narrowband or broadband)	A dermatologist uses a laser to deliver high doses of light only to the psoriasis plaques	Phototherapy is not suitable for patients with genetic predisposition to skin cancer. A clear skin as a result of effective treatment can be maintained for relatively short period (less than six months).
Systemic non-biologic	Plaque psoriasis which cannot be controlled with topical and phototherapy treatment, has a significant impact on patient's psychosocial and physical functioning, and psoriasis is extensive (e.g., more than 10% of body surface area affected).	Methotrexate Ciclosporin	Available as tablets and subcutaneous injections	Common side effects include headaches, nausea, and changes in appetite.
Systemic biologic	Patients with moderate-to-severe psoriasis who do not respond to systemic non-biologic treatment or cannot tolerate their associated side effects. Patients should have had psoriasis for at least 6 months, a psoriasis area severity index (PASI) equal or higher than 10, a dermatology life quality index (DLQI) equal or higher than 10.	Adalimumab Etanercept Infliximab	Administered as subcutaneous injections	Highly effective, however, weaken the immune system, increasing the risk of infections.

In conjunction to the pharmacological management, psoriasis management guidelines recommend a holistic approach in which patients' treatment goals include mental health and lifestyle support (e.g., smoking cessation, alcohol reduction, or weight management) (NICE, 2012). In this context, the Psoriasis and Wellbeing (PsoWell) program (Chisholm et al., 2017) focused on teaching motivational interviewing (MI) skills that aimed at training clinicians to support behaviour change in patients with psoriasis. PsoWell program aimed to increase clinicians knowledge about the relationship between psoriasis and psoriasis-related comorbidities, including obesity, which were previously deemed as overlooked in the clinical management of psoriasis (Chisholm et al., 2016). Authors concluded that the PsoWell training programme can enhance routine clinical management of psoriasis by including MI skills to address a range of psoriasis-related behavioural risk factors, including unhealthy body weight (Chisholm et al., 2017). Whether this approach could affect patients' outcomes and if mental health consideration can be embedded as part of the program is yet to be researched (Chisholm et al., 2016).

Overall, PsoWell is a more comprehensive treatment approach than the conventional pharmacological approach for managing psoriasis. However, such behavioural approach is still limited in use and does not emphasise the psoriasis associated psychological difficulties. To date, there is no published approach that addresses the commonly experienced psychosocial difficulties such as skin embarrassment, shame, unattractiveness, body image issues, low self-esteem, and emotional distress as part of the clinical management of psoriasis (Bhosle, Kulkarni, Feldman, & Balkrishnan, 2006; Ghorbanibirgani, Fallahi-Khoshknab, Zarea, & Abedi, 2016). These psychological challenges may limit people's adherence to a behaviour change advice (Pariser et al., 2016) and may have negative consequences on their overall quality of life (De Arruda & De Moraes, 2001), as discussed above. Therefore, it is

important to focus on a more tailored and comprehensive approach to psoriasis management that considers clinical, comorbid, and psychological factors, potentially driving better patients' outcomes (Gray et al., 2009; Morgan et al., 2013).

1.6. Common psoriasis comorbidities

Patients with psoriasis often live with other health conditions, both physical and psychological. This 'multimorbidity' or co-existence of two or more chronic conditions in the same person often require complex and ongoing care (Soley-Bori et al., 2021). The next sections will outline common psoriasis associated physical and psychological comorbidities. It should be noted that although the comorbid conditions are discussed as either 'physical' or 'psychological' they often interact. For example, multimorbidity of physical illnesses may affect patients' psychosocial functioning because of mobility impairments (Bahali et al., 2017).

1.6.1. Physical comorbidities of psoriasis

Common psoriasis comorbidities include cardiometabolic, kidney, and gastrointestinal diseases (Da Costa et al., 2012; Takeshita et al., 2017). Multimorbidity may lead to mobility impairments and restricted physical activity which may contribute to increased body weight (Zheng et al., 2018). Overweight and obesity are referred as common risk factors for cardiovascular disease, dyslipidaemia, type 2 diabetes, hypertension, sleep disorders, and metabolic syndrome in psoriasis (Lee & Park, 2021). High body weight is much more prevalent in psoriasis (30%-40%) than in the general population (15%-20%) (Mahil et al., 2019). It represents a risk factor for psoriasis onset, greater disease severity, poor response to treatment and compromised quality of life (Armstrong et al., 2012; Duarte et al., 2013; Innamorati et al., 2016). People living with moderate-to-severe psoriasis are more likely to become obese than those with mild disease phenotypes (Odd Ratios of 1.55-3.05 and 1.17-

1.82, respectively) (Edson-Heredia et al., 2014; Naldi et al., 2008). Obese patients are less likely to respond positively to systemic non-biologic treatment (Armstrong et al., 2012; Rodríguez-Cerdeira et al., 2019) and systemic biologic treatment (Albuquerque, Nóbrega, Manco, & Padez, 2017; Skender et al., 1996) than healthy weight patients. Additional details on these associations are covered in Chapter 2.

Beyond the physical burden, obesity is also associated with mental health comorbidities such as depression, as shown by evidence in the general population (Chen et al., 2004; Eckardt et al., 2013; Fabricatore et al., 2011; Kernan, Inzucchi, Sawan, Macko, & Furie, 2013; Yusuf et al., 2005). Such an association in the context of psoriasis remains an investigative priority later in the thesis.

1.6.2. Mental health comorbidities of psoriasis

Chronic physical illnesses such as psoriasis are considered as risk factors for major depressive episodes, and major depressive episodes may be a psychological reaction to the functional impairment associated with psoriasis (Morey, 1988). Psoriasis plaques can appear anywhere on the body, and the ones appearing on uncovered areas may trigger feelings of embarrassment, shame, unattractiveness, body image issues, and low self-esteem (Łakuta & Przybyła-Basista, 2017; Richards, Fortune, Griffiths, & Main, 2001; Sampogna, 2004; Vardy et al., 2002; Weiss, Bergstrom, Weiss, & Kimball, 2003). Such feelings may increase social stigmatisation in social situations, including in a work and study environment, leading to desire to socially isolate which may compromise overall quality of life (De Arruda & De Moraes, 2001). In fact, people who feel stigmatised in social situations due to their psoriasis show greater depressive and anxiety symptoms than those who do not feel stigmatised in those situations (Hrehorów, Salomon, Matusiak, Reich, & Szepietowski, 2012). Pain, itch,

and the physical burden of psoriasis may also increase the risk of depression (Griffiths et al., 2018; Martínez-Ortega et al., 2019). Incidence of depression in psoriasis is estimated to be up to 30% (Weiss et al., 2002) which is much higher than the prevalence in the general population (estimate of 12.9%) (Lim et al., 2018; Wu et al., 2017) and in any other dermatological conditions (Gupta & Gupta, 1998).

The observed increased risk of depression in people living with psoriasis might also have a biological cause. Depression is thought to have a strong inflammatory (e.g., elevated inflammatory mediators) (Allison & Ditor, 2014; Dowlati et al., 2010) and hormonal component (Tohid, Aleem, & Jackson, 2016). Hormones such as melatonin has immunomodulatory properties and acts on the immune system by regulating cytokine production of immunocompetent cells (Kartha et al., 2014). Thus, melatonin may improve the clinical course of illnesses which have an inflammatory aetiology such as psoriasis (Esposito & Cuzzocrea, 2010). Low melatonin levels have been observed in people with psoriasis (Esposito & Cuzzocrea, 2010; Kartha et al., 2014). This hormonal dysregulation of the melatonin levels has been also used to explain the high levels of depression in people living with psoriasis (Kartha et al., 2014). Normalisation of the melatonin levels has been linked to reduction in the depressive symptoms and the clearance of the psoriatic plaques (Kartha et al., 2014; Sandyk & Pardeshi, 1990).

While most of the evidence is convincing that there is indeed a positive association between depression and psoriasis, other common aetiological variables, such as genetic and epigenetic factors, or comorbid conditions may have a role in both conditions and exacerbate each other. For example, depression is hypothesised to increase the risk of obesity in the general population (McElroy et al., 2004) and obesity is reported as a risk factor for future mental

disorders (Golden et al., 2008; Roberts, Deleger, Strawbridge, & Kaplan, 2003). Despite the confirmed high rates of obesity in psoriasis (30-40% vs. 15-20% in the general population), and the extensively studied association between mental health and obesity in the general population, the evidence of the association between mental health and psoriasis rarely considers excess weight as a factor that may add additional burden to psoriasis.

Important nuances related to demographic factors should also be considered in the association between mental health and psoriasis. Women perceived psoriasis to have a stronger negative impact on their mental health than men (Böhm et al., 2013). Findings from the general population confirmed that depression and anxiety affected women disproportionately when compared to men (Golpour et al., 2012). However, these gender differences have not yet been investigated for people living with psoriasis. Some studies have explored the relationship between age and mental health in psoriasis indicated that older age was associated with mental health impairments because of psoriasis (Fernandez-Torres, Paradelo, & Fonseca, 2012; Miniszewska, Chodkiewicz, Ograczyk, & Zalewska-Janowska, 2013; Tadros et al., 2011). These findings suggest that adapting to psoriasis later in life may be more challenging than adapting to psoriasis earlier in life, when a patient is younger and has more time to learn how to cope with the unpleasant feelings associated with the disease (Miniszewska, Chodkiewicz, et al., 2013). Therefore, age appears as an important demographic characteristic that needs to be considered as a possible confounding factor when assessing the association between psychological factors and psoriasis.

Differences in mental health also exist in terms of the disease characteristics such as location of the psoriasis lesion, disease activity and severity. People with visible psoriasis lesions

reported worse mental health as compared to people with less visible lesions (Daudén, Herrera, et al., 2013). Studies that link disease severity and activity to mental health suggested that the impact on mental health is greater for people who experience frequent flare-ups than those who have longer periods in remission (Daudén, Herrera, et al., 2013). Objective disease severity (i.e., from the clinician's perspective) has been associated with mental health in several studies, where improvements in psoriasis clinical manifestation were linked to less impairments in mental health (Blome et al., 2010; Daudén, Pujol, et al., 2013; Fernandez-Torres et al., 2012; Miniszewska, Chodkiewicz, et al., 2013; Miniszewska, Juczyski, Ograczyk, & Zalewska, 2013). Beyond the objective evaluation of psoriasis, the subjective one (i.e., from the patient perspective) is also important in relation to patients' outcomes. Studies showed that patients who perceive their illness as severe had higher levels of depression and reported lower quality of life than patients who perceive their illness as mild or moderate-to-severe (Pereira, Brito, & Smith, 2012).

In terms of the relationship between treatment type and mental health, several studies indicate that rates of depression, anxiety, and overall quality of life are influenced by the type of psoriasis treatment. Lower rates of self-reported depression and anxiety, and better quality of life was achieved in people who were treated with systemic therapies (Miniszewska et al., 2013). A comparison between people on systemic treatment to those on topical treatment revealed that those on systemic treatment reported better mental health and quality of life (Blome et al., 2010; Jacobi, Kupke, Behzad, & Hertl, 2013; Norlin, Steen Carlsson, Persson, & Schmitt-Egenolf, 2012). Topical treatments are commonly associated with non-adherence as people viewed them as inconvenient (due to their slow absorption and frequent application of more than once daily), putting extra burden on the patient, while offering limited effectiveness (Zschocke, Mrowietz, Karakasili, & Reich, 2014). Systemic therapies, on

another hand, are more effective and have less burdensome requirements in terms of intake, although may present with more side effects to which patients seem to adapt overtime (Meyer et al., 2010; Raho, Mihajlova Koleva, Garattini, & Naldi, 2012).

Together these findings in relation to potentially relevant demographic and illness-related factors suggest that these should be considered when evaluating the association between mental health and psoriasis. These factors include comorbid conditions such as body weight, demographic and illness-related characteristics, and treatment differences. Multimorbidity, including excess body weight can add additional mental health burden on people living with psoriasis and vice versa – worsened mental health may exacerbate unhealthy lifestyle behaviours, including limited physical activity, contributing to obesity. Females, people older in age, those with moderate-to-severe psoriasis (both objectively and subjectively measured), and people on topical treatments may be particularly at risk for impaired mental health and overall quality of life. Including these factors in the evaluation of the association between mental health and psoriasis may inform clinical practices and potentially contribute to more tailored management approaches.

1.7. Conclusive remarks of the chapter

This chapter introduced the clinical features of psoriasis and demonstrated its substantive physical and psychosocial burden. Common comorbidities, mainly obesity, were discussed and their anticipated physical and psychological consequences in the context of psoriasis. Given the evidence from the general literature, obesity can exacerbate the already high psoriasis burden and vice versa – the high psoriasis burden can limit patient social interactions and affect their physical activity levels, ultimately driving higher body weight.

Therefore, it is important to consider the burden of psoriasis beyond its associated clinical and objectively assessed symptoms. Moving beyond the conventional approach, the focus needs to be on commonly associated psoriasis comorbidities such as obesity and psychological factors. The next chapter will provide an overview of obesity in psoriasis by emphasising on the association between both conditions.

Chapter 2: Obesity in Psoriasis

2.1. Chapter overview

The previous chapter introduced the clinical characteristics of psoriasis and briefly defined its link to obesity. This chapter begins by defining obesity and introduces the prevalence of people living with obesity and psoriasis, with a focus on the population within the United Kingdom (UK) where the following research studies were conducted. The illness-related and psychological impact of these co-morbid conditions are discussed. Finally, current obesity management practices in psoriasis are outlined, including consideration of their strengths and limitations. The need for a more integrated approach that considers the possible idiosyncratic challenges of living with obesity and psoriasis is presented.

2.2. Definition of obesity

Obesity, defined as an excessive accumulation of body fat that presents a risk to health (National Health Services (NHS), 2022) is mostly assessed using body mass index (BMI). BMI is calculated as a person's body mass (in kg) divided by the square of their height in meters. There are three interval categories of BMI. A BMI between 18 kg/m² and 24.9 kg/m² is considered 'normal/healthy'. A BMI of 25 kg/m² to 29.9 kg/m² is considered 'overweight'. BMIs of ≥ 30 kg/m² or ≥ 35 kg/m² are considered 'obese' and 'morbidly obese', respectively (NHS, 2019).

Despite its wide use, a key limitation of BMI as a measure is that it neither gives information about body fat distribution nor distinguishes between body fat and lean body mass (Nuttall, 2015). A higher percentage of body fat mass is associated with poor physical and mental health outcomes (Speed, Jefsen, Børglum, Speed, & Østergaard, 2019). Excess body fat mass can be a source of harmful inflammation, especially when distributed around the waist, being indicative of higher visceral body fat (Tharp & Stahl, 2015). To overcome the limitations of BMI, the definition of *abdominal obesity* has been used, in addition to BMI, as it detects excess intra-abdominal (around the waist area) fat deposition. Abdominal obesity is regarded as an informative marker of the associated health risks of obesity such as high blood pressure, type 2 diabetes, and stroke (Jacobsen & Aars, 2016). In psoriasis, abdominal obesity is also established as a strong risk factor for greater disease severity and comorbidity risk, including metabolic syndrome (Han et al., 2019). The threshold for the presence of abdominal obesity has been suggested as >102 cm in males and >88 cm in females (Janssen, Katzmarzyk, & Ross, 2002). Hence, abdominal obesity may be more accurate measure of obesity than BMI in inflammatory conditions with high prevalence of comorbidities such as psoriasis, and thus it is used as additional measure to BMI in the studies within this thesis.

2.3. Prevalence of obesity

Obesity is a leading public health concern, both in the United Kingdom and worldwide (Finucane et al., 2011; Ogden, Carroll, Kit, & Flegal, 2014; Service, 2021). The prevalence of obesity and associated medical conditions (e.g., type 2 diabetes mellitus, cardiovascular diseases, metabolic syndrome, and skin conditions such as psoriasis) has risen dramatically in the last two decades, despite the extensive public health efforts to fight excess weight (Ogden et al., 2014). In 2016 worldwide, there were around 2 billion overweight adults (body mass index (BMI) of ≥ 25 kg/m²). Of these, over 650 million were living with obesity (BMI of ≥ 30 kg/m²) (Iskandar et al., 2015). This translated to 39% of adults aged 18 and over being

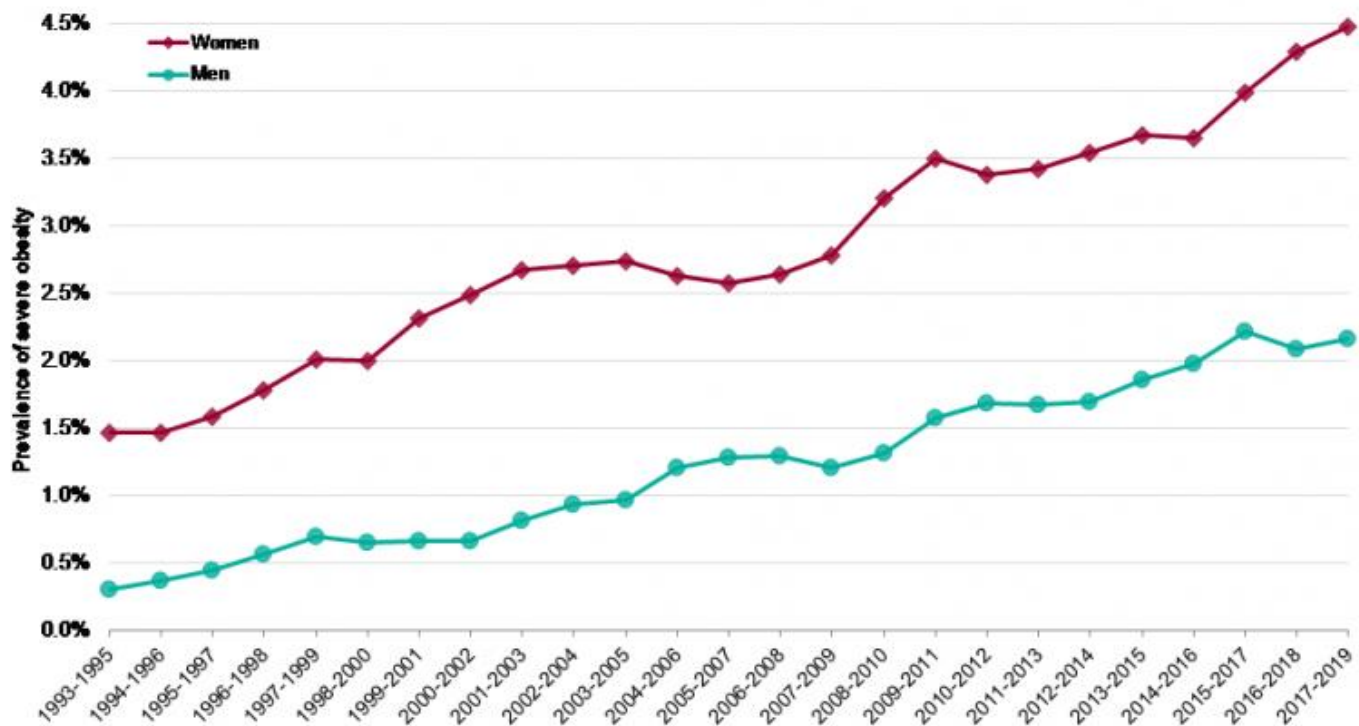
overweight (39% of males and 40% of women). Overall, about 13% of the world's adult population (11% of men and 15% of women) were living with obesity (National Health Services, 2022). Between 1975 and 2016, the global prevalence of obesity nearly tripled. By 2025 if the current trends continue, it is anticipated that 2.7 billion adults will be overweight, of these over 1 billion will be living with obesity, and 177 million people will be living with severe obesity.

2.3.1. Prevalence of obesity in the United Kingdom (UK)

According to the Global Burden of Disease Study, in 2013 the UK had proportionally more adults living with overweight and obesity than anywhere in Western Europe, except Iceland and Malta (Abubakar, Tillmann, & Banerjee, 2015). In the UK, over the last four decades, the number of adults living with obesity has risen dramatically and is much higher than the worldwide prevalence discussed above (13% vs. 28%). According to data from the 1980 National Heights and Weights Survey (Office of Population Censuses and Surveys, 1985), obesity was prevalent in 6% of men and 9% of women aged 16 and over. This prevalence rose to 13% and 16% in men and women respectively in 1993, and rose again to 27% of men and 29% of women in 2019 (Office of Population Censuses and Surveys, 1985; National Health Service, 2021).

The proportion of people who were living with extreme obesity had also increased since 1993 for both men and women. Although just a tiny percentage of the population currently lives with extreme obesity, the rate of increase has been significant between 1993 to 1995 (combined), with men experiencing a 7-fold increase (from 0.3% to 2.2% in 1993 to 1995 combined) and women experiencing a 3-fold increase (increasing from 1.5% to 4.5% in 1993 to 1995 combined). Figure 3 illustrates this increase.

Figure 3: *Trends in prevalence of severe obesity among adults (aged 16 or over) in the UK 1993-2019*



Source: Health Survey for the UK 1993 to 2019 (three-year averages), NHS Digital, (p. 5)

Given the growing recognition of the negative impact of obesity on health, the rapidly rising prevalence of obesity is likely to result in an increase of obesity-related health problems.

Obesity is more common in populations with higher number of chronic conditions (Keramat et al., 2021) such as psoriasis.

2.3.2. Prevalence of obesity in psoriasis

A meta-analytical review of 16 observational studies suggested that people with psoriasis have comorbid obesity (29%) much more commonly than people without psoriasis (18%) (Armstrong et al., 2012; Bhole et al., 2012). The mean BMI for people living with psoriasis (27.9 kg/m²) is significantly higher than the mean BMI in the general population (26.1 kg/m²) (Armstrong et al., 2012). These high rates of obesity in psoriasis may be explained by (i) pre-

existing high body weight that may drive psoriasis onset and (ii) the challenges of existing psoriasis that may trigger unhelpful behaviours such as unhealthy eating and psychical inactivity, contributing to obesity. The latter was briefly covered in Chapter one and will be discussed in more detail below. The following discussion will focus on pre-existing high body weight as a risk factor for psoriasis onset.

2.3.3. Impact of pre-existing high body weight on psoriasis onset

Excess weight has been reported as an independent risk factor for psoriasis onset in numerous observational studies (Armstrong, Armstrong, Fuller, Sockolov, & Voyles, 2011; Herron et al., 2005; Naldi et al., 2005; Wolk et al., 2009). A recent Mendelian randomization study² also confirmed these arguments and indicated that overweight BMI (above 25 kg/m²) is a causative factor for psoriasis onset (Budu-Aggrey et al., 2019). A longitudinal study of 67,300 nurses over 12 years in the UK (Huerta, Rivero, & Rodríguez, 2007) found evidence of a dose-response relationship between severe obesity and psoriasis risk, with a two- to three-fold increase in risk of psoriasis onset among females living with comorbid obesity (BMI \geq 35 kg/m²) compared to healthy weight women (BMI between 18.5 kg/m² and 24.9 kg/m²). The study findings revealed that being overweight and obese raises the incidence of psoriasis by 10-30% (Huerta et al., 2007). The multivariate risk ratios (RR) of incident psoriasis for BMI \geq 35 kg/m² was 1.63 (CI 1.58-2.61) as compared with the reference group with BMI between 18.5 kg/m² and 24.9 kg/m² (Huerta et al., 2007). In a case-control study of 373 people with first-time onset psoriasis within 12 months and matched healthy controls, obesity was associated with a two-fold increased risk of psoriasis onset (Wolk et al., 2009).

² a method from genetic epidemiology which uses data from genome-wide association studies (GWAS) to determine whether a risk factor is causal for an outcome.

For each one unit increase in BMI, there was a 9% higher risk of psoriasis onset (Wolk et al., 2009).

Overall, most evidence that aimed to establish the excess weight as a risk factor for psoriasis onset (such as that excess weight drives psoriasis) is cross-sectional (Armstrong et al., 2011; Herron et al., 2005; Naldi et al., 2005; Wolk et al., 2009) and cannot delineate the time sequence of the occurrence of psoriasis and obesity, where obesity may predates or co-exist with psoriasis (Setia, 2016). The consistencies of the cross-sectional findings with the longitudinal ones (Huerta et al., 2007) are possibly indicative of a causative link between obesity in psoriasis that cannot preclude a potential bidirectional association. Therefore, it is important to explore the bidirectionality of the association between excess weight and psoriasis (Armstrong et al., 2012) and its related physical and psychological burden. The next section will introduce both the disease-related and psychological burden of comorbid obesity in psoriasis.

2.4. Impact of comorbid obesity in pre-existing psoriasis

2.4.1. Disease-related impact of psoriasis and comorbid obesity

Psoriasis and comorbid obesity can have a negative impact on disease-related outcomes such as psoriasis severity and treatment response (Avila et al., 2015). Several cross-sectional and case-control studies demonstrated the incremental effect of obesity on psoriasis severity, suggesting a link between increased body weight and greater psoriasis severity (Huang et al., 2010; Murray, Bergstresser, Adams-Huet, & Cohen, 2009; Hidetoshi Takahashi et al., 2009; Takahashi et al., 2008). The relationship between disease severity and obesity is likely to be bidirectional where people living with moderate-to-severe psoriasis are significantly more likely [odd ratios (OR) 2.23] to have comorbid obesity compared to those with mild

phenotypes (Armstrong et al., 2012). The positive association between psoriasis severity and BMI was confirmed using different measurements of psoriasis severity such as Psoriasis Area Severity Index (PASI) (Takahashi et al., 2009) and Physician Global Assessment (PGA) scores for psoriasis severity (Murray et al., 2009). However, these cross-sectional studies had relatively small sample sizes (less than or slightly over 100 people) and did not consider any confounding factors that may be related to both obesity and psoriasis severity. Common psoriasis- and obesity associated comorbidities such as diabetes, hypertension, hyperlipidaemia may drive greater psoriasis severity via additional biological factors (e.g., insulin resistance in the context of obesity and diabetes) (Takeshita et al., 2017; Da Costa et al., 2012). Living with multimorbid conditions may also increase the psychological burden on patients' lives which may affect obesity management behaviours (Griffiths et al., 2010). Females and people older than 40 years of age who live with psoriasis are also more likely to have obesity (Kaye, Li, & Jick, 2008). Therefore, for more accurate assessments of the bidirectional impact of obesity on psoriasis severity, it is important to account for a variety of factors, including comorbid illnesses or conditions, gender, and age.

Two cross-sectional studies of 399 and 296 people living with psoriasis have considered the importance of demographic and disease-related factors in the association between psoriasis severity and body weight. Their findings indicated that BMI was positively associated with psoriasis severity measured by the objective clinician used PASI, after adjusting for several confounders such as age, gender, cigarette smoking, and disease-related factors such as comorbidities and psoriasis duration (Huang et al., 2010). In people living with BMI of < 25 kg/m², 25 kg/m² to 30 kg/m², and \geq 30 kg/m², median PASI scores (indicative of psoriasis severity, where higher scores indicate greater severity) were 3.9, 6.0, and 7.0, respectively (Salvati et al., 2002). Acknowledgement of the limitations of using BMI as an accurate

indicator of body fat (discussed in the beginning of this chapter) was made by one of these studies (Salvati et al., 2002). The association between waist circumference and waist-to-hip-ratio with psoriasis severity, in addition to BMI, was explored (Salvati et al., 2002). The findings revealed that these additional measures of excess weight correlated to disease severity (i.e., PASI scores) in the same pattern as BMI (Salvati et al., 2002).

Obesity in psoriasis has been also studied in the context of therapeutic effects of certain medications, including systemic biologic treatment that have excellent efficacy and tolerable safety over other systemic mediations for moderate-to-severe psoriasis (Asahina et al., 2016; Kaushik & Lebwohl, 2019b). Obesity is associated with reduced probability of successful treatment with systemic biologic agents by up to 50% (Duarte et al., 2013; Hojgaard et al., 2018; Murray et al., 2009; Snekvik et al., 2017; Warren et al., 2015). In a meta-analysis of 15 studies examining the demographic and clinical factors associated with response to systemic biologic therapy in psoriasis (Edson-Heredia et al., 2014), BMI and body weight were among the most frequently evaluated factors that could have a negative impact on successful treatment. Several studies (Bardazzi et al., 2019; Duarte & Chehin, 2011; Duarte et al., 2013; Duffin et al., 2017; Menter et al., 2010; Naldi et al., 2008; Strober et al., 2019) reported that high BMI and weight negatively influence treatment response, however, there is also evidence that failed to find such an association (Driessen, Boezeman, Van de Kerkhof, & De Jong, 2009; Gordon et al., 2006; Reich et al., 2006). Together these findings suggest that increased baseline BMI or body weight could reduce treatment response to systemic biologic agents, although the data identified is inconclusive. Methodological variations are likely to affect these inconsistent findings. Some studies used various systemic biologic agents in combination (Federico Bardazzi et al., 2019), whereas others (Menter et al., 2010) focused on single systemic biologic treatment. Some systemic biologic agents are administered as fixed-

dose, whereas the administered dose for others is weight-dependant. Another methodological limitation is the fact that one of the studies (Gordon et al., 2006) which reported the lack of association between weight and treatment response (based on improved PASI scores) presented no statistical analysis. Whereas other studies (Menter et al., 2010) that reported increased body weight as an independent predictor of reduced treatment response to systemic biologic agents presented robust statistical analysis, in favour of the association.

In summary, increasing evidence suggests that high body weight may impede the full therapeutic impact of psoriasis treatment (Debbaneh, Millsop, Bhatia, Koo, & Liao, 2014) and it is also associated with greater psoriasis severity (Huang et al., 2010; Murray et al., 2009; Takahashi et al., 2009; Takahashi et al., 2008). A number of likely mechanisms have been postulated for the pathway between high body weight, increased psoriasis severity and poorer psoriasis treatment response. These include (1) decreased medication distribution into body because of the increased body mass, and (2) increased inflammation related to excess body fat (Debbaneh et al., 2014). Psychological factors such as skin embarrassment (defined as negative emotional or behavioural response because of the skin appearance (Mento, Rizzo, Muscatello, Zoccali, & Bruno, 2020) or restricted mobility because of greater disease severity may be barriers to adhering to required obesity management behaviours such as physical activity, strengthening the association of psoriasis and obesity.

2.4.2. Psychological impact of comorbid obesity

Comprehensive searching of the literature at the start of this PhD, indicated a lack of robust evidence on the psychological impact of comorbid obesity in psoriasis. Therefore, this section provides a summary of the psychological burden of psoriasis in general. Then, the discussion moves towards outlining the psychological challenges of obesity, drawing on evidence from

the general literature. This, together with the theoretical framing of the issues covered in chapter four, provides the basis for the formulation of the thesis hypotheses regarding the psychological impact of comorbid obesity in psoriasis.

As discussed in Chapter one, the lifetime prevalence of major depression in psoriasis has been estimated as high as 67% (Dowlatsahi, Wakkee, Arends, & Nijsten, 2014; Golpour et al., 2012; Lamb et al., 2017). However, reported prevalence of depression among people with psoriasis varies by definition and assessment method. Higher point prevalence rates of depression in psoriasis have been identified by self-reported questionnaires (67%) than by standardised diagnostic interview (12%) (Dowlatsahi et al., 2014; Golpour et al., 2012; Lamb et al., 2017). Similarly, obesity is associated with higher rates of depression in the general population in a bidirectional relation, where people who are obese are more likely to report higher levels of depression and vice versa, as demonstrated by two systematic reviews of 15 and 17 studies (De Wit et al., 2010; Luppino et al., 2010).

Psoriasis, comorbid obesity, and depression are individual conditions that could co-occur in bidirectional ways, where obesity may drive mental health issues and vice versa (Innamorati et al., 2016; Kim, Seidler, & Kimball, 2014). This co-occurrence may be due to the physical and emotional challenges that psoriasis and comorbid obesity have on patients' lives (Griffiths et al., 2018; Kouris et al., 2015). Psoriasis and comorbid obesity often co-occur with other comorbidities such as cardiometabolic, kidney, and gastrointestinal diseases (Clark, Hampson, Avery, & Simpson, 2004; Ryan, Dockray, & Linehan, 2019) that may additionally increase the psychological burden (Rodríguez-Cerdeira et al., 2019). Increased psychological burden may lead to decreased treatment adherence, resulting in treatment dissatisfaction which may also contribute

to depression – based on findings from the general literature that are not yet explored in psoriasis (Griffiths et al., 2010; Heckman, Mathew, & Carpenter, 2015).

Depression is strongly associated with high body weight in the general literature in a bidirectional fashion; where people with obesity have 55% increased risk of developing depression over time and depressed people have 58% increased risk of becoming obese, findings that are confirmed in both cross-sectional and longitudinal studies (De Wit et al., 2010; Luppino et al., 2010). There are several possible mechanisms explaining these associations. In terms of obesity as an exposure for depression, obesity can be seen as an inflammatory state, as weight gain has been shown to activate inflammatory pathways (Emery et al., 2007; Shoelson, Herrero, & Naaz, 2007) and inflammation in turn has been associated with depression (Bremmer et al., 2008; Milaneschi et al., 2009; Vaccarino et al., 2007). In addition to the biological mechanisms, psychological factors can also play a role. Being overweight and obese and the perceptions of overweight and obesity increases psychological distress (Atlantis & Ball, 2008; Derenne & Beresin, 2006). Thinness is considered a beauty ideal across Europe and because of social acceptance and sociocultural factors, obesity may increase body dissatisfaction and decrease self-esteem, which are both risk factors for depression (Hoek et al., 2005). Disturbed eating patterns and eating disorder, as well as experiencing physical pain as a direct consequence of obesity, are also known to increase the risk of depression (Beesdo et al., 2010; Gadalla & Piran, 2008).

In terms of the effect of depression on obesity, neuroendocrine disturbances related to depression may predispose depressed people to an increased body weight. The long-term activation of the Hypothalamic-pituitary-adrenal-axis dysregulation (HPA axis) is well known to be involved in depression and may lead to obesity (Belanoff, Kalehzan, Sund, Fleming Ficek, & Schatzberg, 2001; Holsboer, 2000). Another important mechanism are lifestyle factors, such as insufficient

physical activity and unhealthy dietary preferences, as a result of the challenges of living with depression, possibly leading to obesity (Luppino et al., 2010).

In summary, the prevalence of depression in psoriasis is much higher than in the one in the general population. There are both biological and psychosocial explanations for the bidirectional association between depression and obesity in the general population. Despite the robust evidence of these associations, it should be noted that methodological differences across the studies might impact on their conclusions. For example, the association between obesity and depression is stronger when depression is assessed via clinical interview rather than when using self-reported questionnaires. This could be due to greater precision when confirmed by a psychiatric diagnosis, whereas self-reported depressive symptoms may be more often biased by confounding variables (Luppino et al., 2010). Most studies in the general population that assessed the associations also had relatively small sample sizes and did not adjust for a wide range of covariates that might have affected the conclusions (Luppino et al., 2010). Future studies that aim to explore the potential association between psychosocial challenges, including depression, obesity, and psoriasis should consider important confounders in their evaluations to acknowledge limitations of the previous evidence. A robust understanding of the psychosocial factors that play a role in the association between psoriasis and obesity may assist with designing tailored weight loss interventions which can ultimately lead to better psychological and psoriasis-related outcomes (Clark et al., 2004; Peckmezian & Hay, 2017b).

2.5. Weight loss interventions

2.5.1. Obesity management interventions in the general literature

A recent systematic review of international evidence-based guidelines for weight loss in the general population (Semlitsch, Stigler, Jeitler, Horvath, & Siebenhofer, 2019) outlined different weight loss approaches, including lifestyle changes focused on diet, physical

activity, and behavioural intervention, pharmacological weight-reduction interventions, and bariatric surgery. Pharmacological weight-reduction is only recommended as an adjunct to lifestyle interventions (Semlitsch et al., 2019). Bariatric surgery is a treatment option in adults with BMI greater than or equal to 40 kg/m² or a BMI of greater than or equal to 35 kg/m² with weight-related complications, when all non-surgical weight loss interventions have failed (Semlitsch et al., 2019). Regardless of whether weight reduction is achieved via pharmacological treatment or bariatric surgery, lifestyle modifications on physical activity and dietary intake are required for long-term weight maintenance (Soleymani, Daniel, & Garvey, 2016).

Multifactorial comprehensive lifestyle programs that include calorie intake reduction, increased physical activity and behavioural change support are recommended as a baseline therapy for adults with BMI of greater than or equal to 25 kg/m². After weight reduction, long-term measures to maintain reduced weight are also recommended. These may include a balanced diet, increased physical activity, and behavioural support (Soleymani et al., 2016).

2.5.1.1. Dietary interventions

Dietary interventions are recommended treatment approaches that focus on promoting a balanced diet which should result in a daily energy deficit of 500 to 750 kcal (Soleymani et al., 2016). Unduly restrictive and nutritionally unbalanced diets, or fad diets, are not recommended and should be always delivered under medical supervision, if needed (e.g., in circumstances when faster weight loss is required). A recent systematic review of non-surgical weight loss interventions suggested that low-carbohydrate and low-fat diets are the most effective intervention for adults living with overweight or obesity when followed for a period of six months (Twells et al., 2021). The studied low-carbohydrates and low-fat diets

included increased intake of dietary pulses, recommended intermittent energy restrictions, and were based on low glycaemic index. Reported findings are consistent, indicating significant weight loss because of these diets, ranging from 1.66kgs to 3.90kgs (Chiavaroli et al., 2021; Harris et al., 2018; Zafar et al., 2019). One network meta-analysis (Johnston et al., 2014) examined the effectiveness of popular self-administered commercial diets in adults living with overweight and/or obesity, including low-carbohydrate diets such as Atkins, Zone, and Weight Watchers and low-fat diets such as Ornish and Rosemary Conley. The meta-analysis included 48 RCTs and reported significant findings in terms of weight loss, while adjusting for behavioural support and weight loss (Johnston et al., 2014). Commercial diets resulted in weight loss of 8.73 and 7.25 kgs at 6 and 12 months, respectively. While commercial low-fat diets led to weight losses of 7.99 kgs and 7.27 kgs at 6 and 12 months, respectively. Weight loss differences between individual diets were minimal (Johnston et al., 2014). All of the weight loss parameters mentioned above translated to more than 5% of the lost weight from the baseline weight, considered as clinically meaningful outcome (Williamson, Bray, & Ryan, 2015).

Limitations of these studies should be noted. Most of the dietary interventions lasted between 3 and 52 weeks and most of the enrolled participants were females. Across all studies, a larger weight loss was reported in the short term (e.g., up to 6 months) compared with long term (e.g., 12 months), suggesting additional support may be needed to support weight maintenance over time. The impact of behavioural support and exercise on weight loss outcomes differed between 6 and 12 months. Behavioural support enhanced weight loss at 6 months (3.23 kgs, 95% CI 2.23 – 4.23 kg) but not at 12 months (1.08 kgs, 95% CI 1.82- 3.96 kg); while exercise did not affect weight loss at 6 months (0.64 kgs, 95% CI -0.35 – 1.66 kg) but did at 12 months (2.13 kgs, 95% CI 0.43 – 3.85 kg). These findings suggested that weight

loss maintenance interventions may be different from those that support initial weight loss (Twells et al., 2021; Johnston et al., 2014), possibly requiring the implementation of other interventional approaches such as physical activity and behavioural therapy.

2.5.1.2. Physical activity and behavioural interventions

Physical activity and behavioural therapy are often considered as an adjunct weight loss strategy, in addition to dietary intervention. Minimal weight losses of less than 2.0 kgs were reported from interventions that included only one modality such as physical activity or behavioural therapy which suggest that combination therapies may be more effective (Twells et al., 2021). Physical activity, although important for improving plethora of health outcomes, including maintenance of weight loss, may not be an effective intervention for achieving weight loss (Swift et al., 2018). Several studies involving overweight or obese individuals at baseline confirmed these findings by investigating the weight changes from aerobic exercise regimen. The Dose Response to Exercise in Women study (n = 464) (Church et al., 2007) observed no significant changes in body weight in women exercising at 50% (− 0.4 kg), 100% (− 2.2 kg) and 150% (− 0.6 kg) of public health guidelines (150 or more minutes of moderate PA per week) for 6 months despite greater than 89% adherence in all exercise groups. The Inflammation and Exercise study (n = 129) (Johannsen et al., 2013) observed no significant change in body weight (− 0.4 kg) compared to the control group (0.1 kg) after 4 months of exercise training. The Studies of a Targeted Risk Reduction Intervention through Defined Exercise study (n = 84) (Kraus et al., 2002) observed significant, but minimal weight loss in those exercising at low amount/moderate intensity (− 0.6 kg, 176 min/week), low amount/high intensity (− 0.2 kg, 117 min/week), or high amount high intensity (− 1.5 kg, 171 min/week) following 6 months of aerobic exercise training. The Diabetes Aerobic and Resistance Exercise study (n = 251) (Sigal et al., 2007) observed significant, albeit small,

weight loss in the aerobic exercise training group (-0.74 kg) compared to the control group after 22 weeks of intervention in adults with T2DM. Thus, overweight and obese adults who adhere to an exercise program consistent with public health recommendations without a dietary plan involving caloric reduction can expect weight loss in a range of ‘no weight loss’ to approximately 2 kg. Such a reduction in weight may not be enough to improve health and ameliorate many high body weight associated comorbidities (e.g., diabetes and metabolic syndrome) that require at least 5-10% weight loss from the baseline weight maintained for a year (Soleymani et al., 2016). Thus, an increase in physical activity or exercise alone with no consideration of decreased calorie intake is unlikely to lead to weight loss in overweight or obese individuals (Twells et al., 2021; Soleymani et al., 2016).

In addition to the dietary and physical activity recommendations, behavioural approaches, including motivational interviewing and cognitive behavioural therapy (CBT), are also encouraged for increased weight loss outcomes and improved adherence to health-related behaviours such as physical activity. A recent systematic review concluded that the most effective weight loss intervention for adults with overweight or obesity included CBT, motivational interviewing and habit-based interventions (Twells et al., 2021). When comparing CBT weight loss interventions (which include lifestyle modifications of dietary changes and physical activity) versus usual care or lifestyle interventions, CBT weight loss interventions resulted in significantly more weight loss than the comparator interventions (-1.70 kgs, 95% CI -2.52 - -0.86 kg) and also decreased emotional eating tendencies, outlined by recent meta-analysis of 12 RCTs (Jacob et al., 2018). Another meta-analysis of 12 RCTs examined motivational interviewing compared with standard dietary care for adults living with overweight or obesity (Armstrong et al., 2011). Findings suggested a significant difference in the lost weight for those in the intervention group compared with those in the

control group (-1.47 kgs, 95% CI -2.05 - -0.88 kg) (Armstrong et al., 2011), weight changes that suggested clinically meaningful outcomes (Williamson et al., 2015).

Limitations of the research included in this meta-analysis were observed. Most of the examined interventions were shorter than 6 months which may be indicative of the likely minimal interventions effects, also questioning the maintenance of the positive weight loss effects in the long term (Twells et al., 2021). Most studies included mainly females which suggest selection bias that limit the generalisability of the findings to other populations, including males. Females are much more likely to seek weight loss help than men which highlighted the need to prioritise the development of weight loss interventions that would appeal to men (Price, Gregory, & Twells, 2013). Despite these limitations, when used as an adjunct therapy to dietary interventions with or without physical activity regimen, behavioural therapy increased weight loss (Twells et al., 2021). As weight loss interventions involve engaging patients in a variety of behavioural changes, it can be argued that behavioural therapy should be integrated into all obesity management interventions (Wharton et al., 2020).

2.5.2. Psychological barriers to weight loss

Despite the effectiveness of above discussed weight loss intervention approaches, psychosocial factors that may hinder positive weight loss outcomes include body image issues, high weight loss expectations, low motivation, impaired self-confidence and perception of self (Burgess, Hassmén, & Pumpa, 2017; Greaves, Poltawski, Garside, & Briscoe, 2017; Grossi et al., 2006; Jung & Luck-Sikorski, 2019; Moroshko, Brennan, & O'Brien, 2011; Ohsiek & Williams, 2011). People with obesity frequently face a negative attitude, prejudice, and discrimination due to a belief that obesity is evolved from a lack of

willpower, laziness, and/or emotional turmoil (Avila et al., 2015). In some cases, people living with obesity have been confronted with similar preconceived notions when consulting the medical profession, resulting in patients feeling misinterpreted, humiliated, neglected, and rejected (Avila et al., 2015). This exerts a huge psychosocial burden on people living with obesity, who struggle with issues related to mood, self-esteem, quality of life, and body image. It has been estimated that 20-60% of individuals with obesity suffer from a psychiatric illness such as depression, anxiety, eating disorders, and substance abuse (Puhl et al., 2009; 2010) – conditions that have been associated with weight regain (i.e., relapse) even after successful weight loss (Werrij et al., 2009). Relapse avoidance and successful weight loss maintenance strategies involve developing skills and coping strategies in behavioural (e.g., diet and physical activity) and emotional domains (self-control over impulsiveness, social support, finding solutions other than food to cope with emotional challenges) (Byrne, 2002; Perri et al., 2001). For successful weight loss maintenance, these behavioural changes need to be practiced until they become automatically defaulted long-term habits. Even then, small lapses occur and require considerable effort to overcome (Byrne, 2002; Perri et al., 2001).

Evidence from the general literature indicated that there is a large emotional dimension to weight loss relapse. Food is deeply embedded in the functioning of both our emotive and reasoned thoughts and actions (Stubbs et al., 2012). This has consequences for the way we interact with food; the way we use food for social and emotive purposes; for our ability to form planned, reasoned behavioural pathways to manage energy balance by controlling our food intake and/or physical activity (Stubbs & Lavin, 2013). Modern society stigmatises people who are overweight and who consume energy more than requirements (despite the fact we are designed to do so) (Puhl & Heuer, 2009, 2010; Rogge, Greenwald, & Golden, 2004; Stubbs & Lavin, 2013). At the same time, marketing, and the media offer food as a

major source of comforting and soothing (Stubbs & Lavin, 2013). This creates emotional conflict by putting the intentions of our planned weight management behaviours at odds with our physiological design, which is to eat in the face of plenty, to protect ourselves from uncertainty in the food supply (Nunes-Neto et al., 2018; Stubbs & Tolcamp, 2006) and to respond to energy deficits by compensating energy intake and expenditure.

Low self-esteem is another factor that has been suggested as a trigger for weight loss relapse (Iannaccone, D'Olimpio, Cella, & Cotrufo, 2016; Klaczynski, Goold, & Mudry, 2004). A survey of 3394 men and women suggested that women rated depression, stress, and low self-esteem as key reasons for weight gain (Cachelin, Striegel-Moore, & Elder, 1998). Similarly, several characteristics have an identified associated with weight gain. These include failure to achieve weight goals and dissatisfaction with weight achieved; tendency to evaluate worth in terms of weight and shape; lack of vigilance regarding weight control; dichotomous thinking (also known as black and white thinking i.e., weight outcome is either good or bad); and a tendency to use food to regulate mood (Byrne, Cooper, & Fairburn, 2003; Byrne, 2002).

Feelings of failure, stigma, self-criticism, and shame may be key factors that influence whether a lapse becomes a relapse. As a stigmatised condition, obesity invokes criticism from others (Stubbs & Lavin, 2013). Criticism from others may undermine our weight control capability and motivation, and ultimately increase our own self-criticism (Duarte et al., 2017). Self-criticism stimulates emotional threat system. A sense of threat leads people to become defensive, to be stressed and to seek comfort (Duarte et al., 2017). A major source of comfort is food (Spence, 2017). Thus, when people experience a weight lapse, they can become trapped in a chaotic emotional cycle which derails strategies of planned behaviour (Spence, 2017). Therefore, there is a complex relationship between physiology, emotion, and

behaviour which can affect strategies of weight loss and weight loss maintenance (Stubbs & Lavin, 2013). This highlights the multifactorial nature of successful behaviour change implementation that should include components such as engagement, motivation, guidance on and encouragement of healthy choices, and ways to cope with lapses to support behaviour change until it becomes the basis of healthy habits.

2.5.3. Weight loss intervention in psoriasis

Seven RCTs, summarised in Table 3, explored the impact of a weight-reduction lifestyle intervention on psoriasis severity. All of the RCTs focused on general behavioural weight loss models aimed at improving dietary habits and physical activity; of those six trials focused on calorie-restricted diets (Al-Mutairi & Nour, 2014; Del Giglio, Gisondi, Tessari, & Girolomoni, 2012; Gisondi, Del Giglio, Di Francesco, Zamboni, & Girolomoni, 2008; Guida et al., 2014; Jensen et al., 2013; Kimball, Alavian, Alora-Palli, & Bagel, 2012), and one trial combined a calorie-restricted diet with a physical activity programme (Naldi et al., 2014).

Three of the trials that focused on calorie-restricted diets (Al-Mutairi & Nour, 2014; Guida et al., 2014; Jensen et al., 2013) randomised people living with psoriasis and high body weight (above the overweight threshold of BMI = 25) to either a calorie restricted diet (intervention group) or routine dietary guidance (control group). Findings from two of the trials indicated that (1) people who were randomised to the intervention group lost significantly more weight than those who were in the control group and (2) people from the intervention group observed significant improvements in psoriasis severity (measured by PASI scores) as compared to people from the control group (Al-Mutairi & Nour, 2014; Guida et al., 2014).

The third trial (Jensen et al., 2013) had the same objectives of assessing the impact of weight loss on psoriasis severity outcomes and made the same observation. However, the observed differences were nonsignificant explained as a result of the drastic weight loss achieved in the

first half of the intervention period (first 8 weeks) which then diminished over the second half of the intervention period when increased calorie intake was assigned. Once calorie intake was increased, psoriasis severity also levelled out (Tomiyama et al., 2010).

The effectiveness of weight loss was also assessed in the context of psoriasis treatment response (Gisondi et al., 2008; Kimball et al., 2012). Two RCTs assessed the impact of weight loss on treatment response with ciclosporin (Gisondi et al., 2008) and phototherapy (Kimball et al., 2012). Findings indicated that weight loss improved the response to ciclosporin over 24 weeks (Gisondi et al., 2008), however, weight loss did not lead to improvements in phototherapy response over 12 weeks (Kimball et al., 2012). Different durations of the interventions may potentially explain these inconsistent findings, or it may be that different treatment regimens when combined with weight loss are likely to yield different response outcomes. Such arguments are confirmed by the findings that improved psoriasis severity cannot be maintained with weight loss only when systemic treatment is discontinued (Del Giglio et al., 2012).

Table 3. *Summary of the randomised-controlled trials using lifestyle weight loss intervention in adults with psoriasis*

Study	Intervention type	N	Intervention duration	Weight Change* (%)	PASI75** (%)	p ***	Findings interpretation
Al-Mutairi & Nour (2014)	Calorie-restricted diet	262	24 weeks	Intervention: -13.0% Control: -1.5%	%PASI75 Intervention: 85.9% Control: 59.3%	< 0.001	Weight loss (>10%) improves moderate-to-severe psoriasis.
Del Giglio et al. (2012)	Calorie-restricted diet	42	24 weeks	Intervention: -9.0% Control: 0%	%PASI75 Intervention: PASI worsened over time Control: PASI worsened over time	> 0.05	Weight loss (5-10%) cannot maintain moderate/severe psoriasis remission after methotrexate is stopped.
Gisondi et al. (2008)	Calorie-restricted diet	61	24 weeks	Intervention: -7.0% Control: -0.2%	%PASI75 Intervention: 66.7% Control: 29.0%	< 0.001	Weight loss (5-10%) improves response to ciclosporin in moderate/severe psoriasis.
Guida et al. (2014)	Calorie-restricted diet	44	24 weeks	Intervention: -11.4% Control: +2.1%	%PASI75 Intervention: -5.1±1.8 Control: -1.1±2.4	0.021	Weight loss of more than 10% improves mild psoriasis.
Jensen et al. (2013)	Calorie-restricted diet	60	16 weeks	Intervention: -14.8% Control: -0.4%	%PASI75 Intervention: -2.3±3.8 Control: -0.3±3.8	0.060	Weight loss of more than 10% improves mild psoriasis.
Kimball et al. (2012)	Calorie-restricted diet	30	12 weeks	Ornish diet: -8.0% South Beach diet: -7.0% Control: 0%	%PASI75 Ornish diet: 83.0% South Beach diet: 56.0% Control: 38.0%	0.300	Weight loss (between 5-10%) does not improve response to phototherapy in moderate-to-severe psoriasis.
Naldi et al. (2014)	Calorie-restricted diet and physical activity	303	20 weeks	Intervention: -3.0% Control: -1.8%	%PASI75 Intervention: 24.5% Control: 19.1%	0.250	Weight loss of less than 5% did not improve in mild psoriasis.

Note: *weight change from baseline to post intervention by group; **% of people achieving PASI75, indicative of 75% or greater reduction in PASI scores from baseline, marking excellent disease improvement (Abrouk et al., 2017); ***improvements in psoriasis severity (measured by PASI75% following weight loss change).

Although evidence from these studies is promising in terms of reduced psoriasis severity and improved treatment response (Kisielnicka, Szczerkowska-Dobosz, & Nowicki, 2020; Mahil et al., 2019), most studies (5/6) that observed significant weight loss because of calorie-restricted diet had small sample sizes (N range from 30 to 61) which questions the generalisability of the observed findings. Intervention duration may be also considered as a limitation since the length of most studies was 6 months or shorter. Based on the evidence from the general population, a larger weight loss is reported in the short term (up to 6 months) compared with long term (i.e., 12 months). Therefore, the long-term maintainability of the lost weight and the observed positive psoriasis effects remain questionable and require further exploration in studies with larger sample sizes and longer durations. Additionally, weight loss interventions in psoriasis are mainly based on one modality (i.e., calorie-restricted diets) and do not consider the recommendation from the general literature of implementing behavioural support into all obesity management interventions (Wharton et al., 2020). This is particularly important as in addition to the challenges that people living with obesity experience such as depression, stress, low self-esteem, dichotomous thinking, and tendency to use food to regulate mood, all linked as key reasons for weight gain (Cachelin et al., 1998; Byrne et al., 2003; Chisholm, Pearce, Chinoy, Warren, & Bundy, 2016; Griffiths et al., 2018), people living with psoriasis may face additional idiosyncratic weight loss related challenges such as embarrassment and stigmatisation not only because of their high body weight but also because of the appearance of psoriasis skin. Currently, these idiosyncratic weight loss related challenges for people living with psoriasis remain unknown.

Understanding of these factors may contribute to the ability to address the multifactorial nature of successful behaviour change implementation in relation to weight loss in psoriasis, proven in the general population. Lastly, none of the weight loss interventions in psoriasis used theory-based approaches. Theory-based tailored illness-specific weight-loss

interventions that address psychosocial difficulties, including emotional and behavioural issues, provide a more balanced approach to weight loss (Clark et al., 2004; Peckmezian & Hay, 2017b). Thus, they may be more effective in supporting weight loss than generic ones and ultimately lead to better weight loss, psoriasis and psychological outcomes (Ogdie & Eder, 2020; Ryan et al., 2019).

2.6. Concluding remarks of the chapter

The current chapter discussed the prevalence of obesity worldwide and in the UK and outlined the link between obesity and psoriasis. Previous obesity management practices in psoriasis are mainly focused on general behavioural weight loss intervention that aimed at improving dietary habits through calorie restricted diets which maintainability in the long term is questionable. Weight loss interventions in psoriasis also failed to acknowledge the evidence from the general population that points towards the use of combined weight loss strategies, including psychological support. Idiosyncratic psychological challenges that may be related to body weight in psoriasis are currently unknown and remain an investigative priority to allow the design of tailored weight loss interventions in psoriasis. Therefore, it is important to systematically explore the literature to date on the psychosocial factors of obesity in psoriasis that may be included in future behavioural based intervention for weight loss in psoriasis. The next chapter includes a systematic review of the literature that investigated the psychosocial factors of obesity in psoriasis.

Chapter 3: Psychosocial aspects of obesity in adults with psoriasis: a systematic review

3.1. Chapter overview

The previous chapters highlighted that obesity in psoriasis is a clinically important issue. The discussion demonstrated the need to identify the factors associated with obesity in psoriasis so that a more comprehensive understanding is developed. This knowledge can inform the development of a behaviour-change weight loss interventions tailored to the needs of people living with psoriasis. This chapter presents a systematic review which aimed to investigate evidence of the association between obesity and relevant psychosocial aspects in adults with psoriasis.

The systematic review was an essential step towards achieving the aims of this thesis. It was necessary to synthesise and evaluate existing evidence on factors associated with obesity in psoriasis to provide a clear picture of what was already known about the subject, and to identify factors to be considered in a behaviour change weight loss intervention. The systematic review also played an important role in informing the direction of the empirical studies in this thesis. The findings of the review were used to inform the cross-sectional and longitudinal study using clinical dataset by highlighting gaps in the literature, and identifying factors that warranted further investigation (i.e., considering the role of demographic and illness variables and using a fat-sensitive measures of weight such as waist circumference in assessing the association between obesity and psoriasis). The review also informed the qualitative study which emerged as a previously unexplored method for looking into the association between obesity and psoriasis from a psychosocial perspective. Finally, the findings of the review contributed to the conclusions of the psychosocial factors that need to be considered in future behaviour change weight loss interventions.

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Note: Relevant supplementary materials from this study are presented in Appendix A of this thesis.

3.2. Published article

Psychosocial aspects of obesity in adults with psoriasis: A systematic review

N.T. Pavlova, MSc^{1*}, K., Kioskli, PhD^{4,5}, C. Smith, MD^{1,2}, F. Picariello, PhD¹, L. Rayner, PhD³, R. Moss-Morris, PhD¹

¹ King's College London, Health Psychology Section, Psychology Department, Institute of Psychiatry Psychology and Neuroscience, London, United Kingdom

² St John's Institute of Dermatology, Guy's and St Thomas' NHS Foundation Trust, London, United Kingdom

³ King's College London, Department of Psychological Medicine, Institute of Psychiatry Psychology and Neuroscience, London, United Kingdom

⁴ City, University of London, Department of Computer Science, Centre for Adaptive Computing Systems, London, UK

⁵ Gruppo Maggioli, Research and Development Lab, Athens, Greece

*corresponding author, N. T. Pavlova, neli.pavlova@kcl.ac.uk

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What is already known?

- Maintenance of a healthy body weight offers the opportunity to reduce the significant burden of psoriasis and to improve treatment response.
- Most therapeutic approaches are generic and emphasise diet and physical activity as strategies to reduce weight in the context of psoriasis.
- Yet people with psoriasis face skin-related issues such as embarrassment that may impede their abilities to commit to the recommended weight loss behaviours

What does this study add?

- To unpack the positive association between excess weight and worsen mental health, an in-depth understanding of patients' experiences of living with psoriasis and comorbid obesity is a priority.
- Future well-designed prospective studies should recognise the complex and perhaps multifactorial nature of managing body weight in the context of psoriasis.
- The inclusion of tailored psychosocial support is likely to support healthy body weight management and ultimately patients' outcomes.

Summary

Background: Excess weight is a common (30-40%) multifactorial concern which remains understudied in adults with psoriasis.

Objectives: This systematic review aimed to synthesise the evidence on the psychosocial factors associated with body weight in psoriasis and to use these findings to inform clinical practice. The review was registered with PROSPERO (registration number: CRD42020201138).

Methods: Electronic databases, related reviews, and associated reference lists were searched. Observational and experimental studies reporting on the relation of psychosocial factors to weight-related outcomes in adults with body mass index (BMI) of ≥ 30 kg/m² and psoriasis were eligible. The methodological quality of the included studies was assessed using Critical Appraisal Skills Programme (CASP).

Results: Eighteen studies were included in the review, the majority of which (n=16) examined cross-sectional associations between psychosocial factors and weight outcomes. Although strengths of the associations were heterogeneous, most studies confirmed the positive association between high BMI and increased reports of depression and anxiety, impaired quality of life, deteriorated sleep quality, sexual dysfunction, and daily functioning issues. Only four studies were rated as high quality.

Conclusions: The current evidence of the association between psychosocial factors and weight-related outcomes is largely cross-sectional with unclear directionality of causality. Longitudinal studies are needed to examine the replicability and generalisability of the examined obesity-related psychosocial factors in psoriasis. Theoretical exploration of subgroup differences and similarities may pave the way towards intervention personalisation and ultimately improved patient outcomes.

Plain language summary

Psoriasis is a chronic condition of the skin that affects between two to four people in every 100 people in the Western world. Psoriasis appears as red scales and patches on the surface of the skin that are itchy and sometimes painful. Living with psoriasis negatively affects mental and physical wellbeing. Approximately a third of people with psoriasis have high body weight ('obesity'). This in turn can worsen how well psoriasis responds to treatment and may also trigger psoriasis onset in the first place.

Traditional weight loss interventions that focus on diet and exercise are unlikely to be relevant to the challenges people with psoriasis face. For this reason, the authors of this UK-based study wanted to review all the evidence available on the role of psychological factors, such as low mood, anxiety, and beliefs in body weight in psoriasis. Six electronic literature databases were searched and 18 studies examining the role of psychological factors in body weight of adults with psoriasis were identified. Most studies agreed that increasing weight is linked to low mood, anxiety, and poorer quality of life. However, only one study examined the role of beliefs which are known to be important for achieving and maintaining healthy body weight in the general population. To further understand the role of body weight in psoriasis, we should learn more about patients' experiences of living with this skin condition and comorbid high body weight. Future studies are advised to look beyond diet and physical activity and consider the role of psychological factors in losing weight.

Words: 265

Introduction

Psoriasis and obesity are major public health issues, both on the rise (Icen et al., 2009; Parisi et al., 2020). Psoriasis is a debilitating inflammatory skin disease, affecting an estimated 29.5 million adults worldwide and about 1 million in the UK population (Parisi et al., 2020). A third of people living with psoriasis are obese, defined as a body mass index (BMI) of ≥ 30 kg/m² (Iskandar et al., 2015). Obesity is a risk factor for psoriasis onset and exacerbation (Budu-Aggrey et al., 2019; Snekvik, Nilsen, Romundstad, & Saunes, 2019). Patients with severe psoriasis are more likely to become obese than those with mild disease phenotypes (odd ratios of 1.55-3.05 and 1.17-1.82, respectively) (Armstrong et al., 2012; Duarte et al., 2013). Similarly, obese psoriasis patients are less likely to respond to biologic therapy and systemic treatment than healthy weight patients (Edson-Heredia et al., 2014; Naldi et al., 2008; Rodríguez-Cerdeira et al., 2019; Snekvik et al., 2019)

Obesity in psoriasis is multifactorial and is best understood through a biopsychosocial approach, including the role of genetics, epigenetic, behavioural and environmental factors (Albuquerque et al., 2017). Since genetic factors are non-modifiable, increasing physical activity and improving unhealthy dietary habits may positively affect obesity trends (Skender et al., 1996; Spiegelman & Flier, 2001). Yet people with psoriasis face psoriasis-associated barriers such as embarrassment about their skin condition which may affect their body image negatively, impede physical activity behaviours and affect their self-esteem to live healthily (Pariser et al., 2016). Lifestyle interventions for obese people with psoriasis must address these challenges.

Tailored illness-specific weight-loss interventions that address psychosocial difficulties, including emotional and behavioural issues, provide a more balanced approach to weight loss (Clark et al., 2004; Peckmezian & Hay, 2017b). Thus, they may be more effective in supporting weight loss than generic ones and ultimately lead to better weight loss and psychological outcomes (Ogdie & Eder, 2020; Ryan et al., 2019)

A recent systematic review highlighted that none of the weight loss interventions in psoriasis included consideration of psychological or social factors (Mahil et al., 2019). Instead, general models of weight loss such as low-calorie interventions embedded in pharmacological treatments were used (Al-Mutairi & Nour, 2014; Chi et al., 2015; Gisondi et al., 2008; Kimball et al., 2012; Naldi et al., 2014). It has been shown that weight loss can lead to

improved psoriasis severity in addition to the effects of systemic treatment in the short term, however, weight is typically regained in the long run. This may be due to a failure to address the complex and multifactorial aetiology of obesity observed in the general population (Franz et al., 2007; Mann et al., 2007) yet understudied in psoriasis. Weight loss interventions that look beyond dietary changes and exercise plans are needed. This is aligned with the National Institute for Health and Care Excellence (NICE, 2014) guidelines on psoriasis stipulating the importance of prioritising the patient's psychological well-being in any treatment regimen.

In summary, maintenance of a healthy body weight offers the opportunity to reduce the significant burden of psoriasis. To date, most therapeutic approaches fail to consider the psychosocial factors relevant to weight outcomes in psoriasis (Al-Mutairi & Nour, 2014; Gisondi et al., 2008; Kimball et al., 2012; Naldi et al., 2014). An evidence-based understanding of the specific psychosocial factors implicated in weight in psoriasis might pave the way towards more tailored and effective interventions that address the complex needs of patients with psoriasis, and ultimately, improved patients' outcomes.

This review therefore aimed to (i) identify psychosocial factors³ related to body weight in people with psoriasis and (ii) quantify the magnitude of their relationship by calculating effect sizes, and (iii) identify psychosocial themes⁴ from qualitative studies that discuss psoriasis in the context of body weight.

Materials and methods

Literature search

This systematic review was registered with PROSPERO (registration number: CRD42020201138) and was conducted according to the PRISMA guidelines (Moher, Liberati, Tetzlaff, Altman, & Group, 2009). A literature search was performed in October 2020 using the following databases: PsycInfo, PsychArticles, Medline, Embase, Cinahl, Web of Science, Scopus. A combination of weight-related, psychosocial and psoriasis terms were tailored to each database (Appendix S1). Secondary searching of bibliographies was also performed. The search was limited to full-text articles in English to allow for adequate appraisal of the findings.

³ These may be correlates, predictors, mediators, and moderators.

⁴ These may include modifiable cognitive (e.g. perceptions and attitudes) and social factors (e.g. social support, employment, relationship quality).

Selection criteria

The inclusion and exclusion criteria were specified using the PECOS approach. The selection of relevant articles was performed by two authors (NP and KK).

Table 1. *Inclusion and exclusion criteria*

Criteria	Inclusion criteria
Population	Adults (18 years or older) with diagnosis of psoriasis
Exposure, Comparator and Outcomes	<ul style="list-style-type: none">○ Changes in weight in relation to psychosocial factors○ Psychosocial themes in the context of weight
Study type	<ul style="list-style-type: none">○ Observational studies○ Randomised control trials (RCT) if matching the outcome requirements○ Qualitative studies

Data extraction and assessment

PRISMA guidelines (Liberati et al., 2009) guided the predefined criteria for data extraction that was conducted independently by two authors (NP and KK). Extracted information included: study design, number of participants, characteristics of patient sample (age, mean BMI, psoriasis severity and duration), comparator group, type of (correlate) psychosocial measure, weight-related data such as BMI and/or waist circumference (outcome), key findings.

Most studies (n=16) used the Psoriasis Area and Severity Index (PASI) (S. Feldman et al., 2005) as a measure of disease severity but used different cut-offs. To achieve consistency, we defined psoriasis as mild (PASI<10) and moderate-severe (PASI≥10) based on extracted PASI data and recommended cut-offs (Mrowietz et al., 2011).

BMI categories were defined consistently in all studies as normal weight ($\text{BMI} \leq 25 \text{ kg/m}^2$), overweight ($\text{BMI} 25 \text{ to } 29.9 \text{ kg/m}^2$) and obese ($\text{BMI} \geq 30 \text{ kg/m}^2$).

Methodological quality of the studies was independently assessed by two authors (NP, KK). In event of disagreement, the authors would discuss the matter of it and if solution was not found the opinion of a third author (RMM) would be sought. Quality of observational evidence and the baseline data from the randomised controlled trial was assessed using the Critical Appraisal Skills Program (Programme, 2019) (Table S2; supporting information).

Data analysis

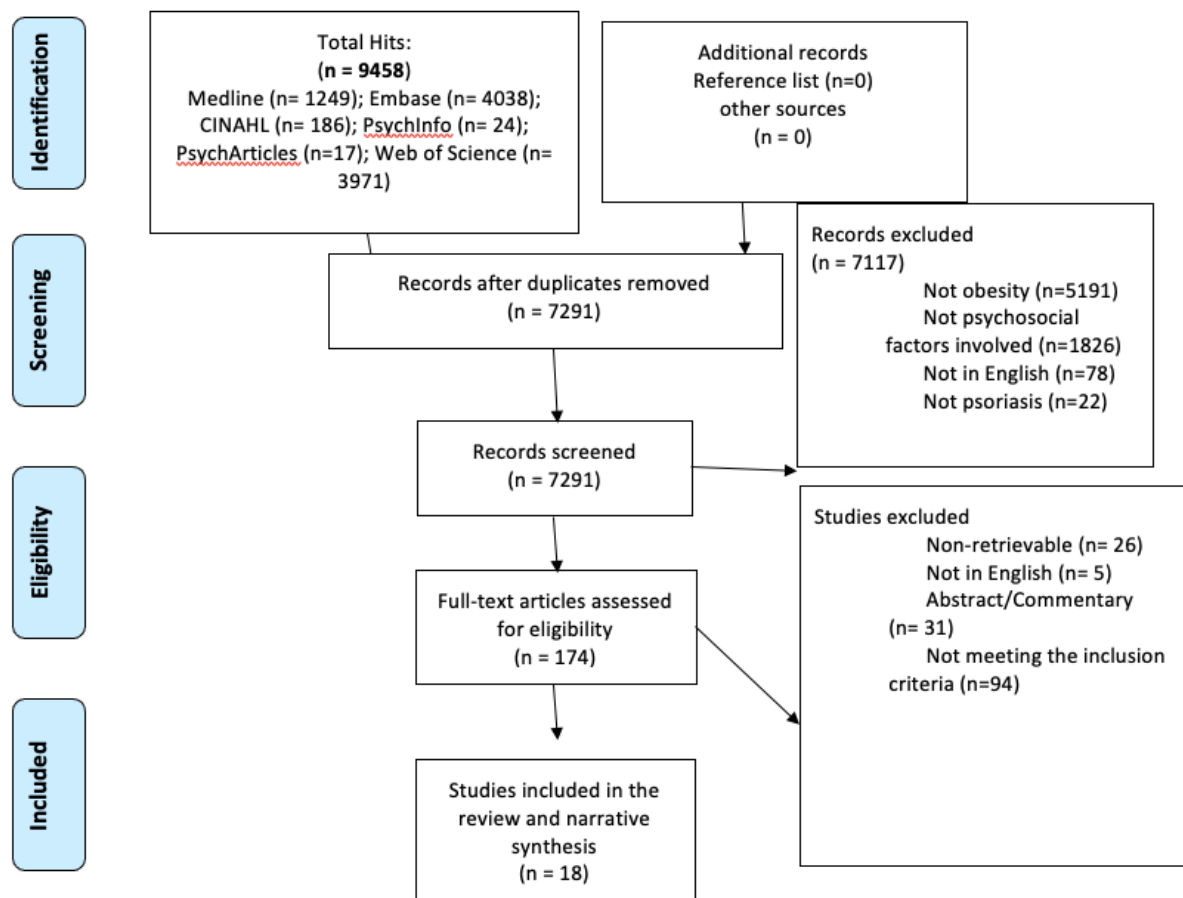
The included studies used different methods to analyse their data. To make meaningful summaries of the effects across them, we calculated the magnitude of associations from correlational methods when enough data (Mean and SD) were available and defined it as weak ($d \leq 0.2$), small ($d=0.2$), medium ($d=0.5$) or large ($d=0.8$) (Chinn, 2000; J. Cohen, 1988). When data were not available, the authors of the eligible papers were contacted for further information.

Results

Study selection and characteristics

A flow diagram for inclusion of studies is depicted in Figure 1. Eighteen studies met the inclusion criteria: one RCT exploring baseline associations, sixteen cross-sectional, one case-control and one retrospective study.

Figure 1. *Flowchart-Selection Process*



The study characteristics are summarised in Table 2 below. The mean BMI in the included studies was ≤ 30 kg/m² (n=16), and mostly considered as a confounding variable in their analyses. Most studies' (n=14) samples consisted of participants with mild psoriasis. Table S1 (supporting information) summarizes the relation of psychosocial factors to weight-related outcomes by psoriasis severity.

Table 2. *Summary of the studies' characteristics*

Author(s) name, date, location, study design	Number of participants , Proportion male (%)	Mean age	Mean BMI (SD); %obese	Mean PASI (SD), psoriasis duration (SD)	Psychosocial assessment tool and factor	Type of analysis	Cohen's d [95% CI]	Correlation r [95% CI] or β	Magnitude of association	p-value
Cohen et al., 2015, US, cross-sectional	N= 351, 48%	50.9 (17.3)	29.6 (6.7)	NR, NR	PHQ-9, depression	BMI < 25 vs >30 BMI < 25 vs. >35	0.84 [1.04-2.20] 0.79 [0.98-2.08]		Large large	0.02* 0.06
					SQI	BMI < 25 vs. >30 BMI < 25 vs. >35	0.70 [0.97-1.65] 0.75 [1.04-1.77]		medium medium	0.12 0.04*
Tabolli et al., 2012, Italy, RCT	N=202, 61.4%		Baseline 27.26 (5.88)	23.16 (12.4), NR	GHQ, depression and anxiety	Correlation	-	β = 0.10 [-1.34-1.54]	weak	>0.05
					SF-36, mental and QoL	Correlation	-	β = 1.40 [-1.28 – 4.07] β = -0.44 [-2.73 – 1.85]	large	>0.05
					Skindex-29 ⁵ , QoL	Correlation	-	Symptoms β =-2.84 [-8.03, 2.36] Emotion β =-4.19 [-9.67, 1.29] Social functioning β =-4.00 [-9.43, 1.43]	Large Large	>.05
Innamorati et al., 2016, Italy, cross-sectional	N= 197, 51%	Mean age= 50.45 (SD= 15.24)	Mean BMI = 27.4 (5.94) 24%	3.90 (3.03), 18.24 (13.46)	SF-12, mental HRQoL, Toronto Alexithymia Scale, alexithymia, Difficulties in	Compared to obese people without psoriasis (N=97), obese individuals with psoriasis indicated more severe alexithymia (p<.001), more difficulties in emotional regulation, anxiety, depression, food cravings, and worse physical and mental health (p<.05).				

⁵ Negative coefficient indicates worsening of symptoms

					emotional regulation scale and factor, SF-12, QoL, HASD, depression					
					SF-12 Health survey, QoL	Mediation analysis	-	$\beta = -0.27$ [-0.48 – -0.06]	weak	0.05*
					SF-12 Health survey, mental HRQoL	Mediation analysis;	-	$\beta = 0.53$ [0.06 – 1.28]	medium	0.05*
Grozdev et al., 2012, USA, cross-sectional	N= 429, 54%	48.7 years (15.4)	Mean BMI-30.4 (SD= 7.5)	23.16 (12.4), NR	SF-12 Health survey, mental HRQoL	Correlation		$\beta = 0.10$ [-0.05 – 0.25]	weak	0.210
					SF-12 Health survey, QoL			$\beta = -0.47$ [-0.63 – -0.32]	medium	.001*
Crosta et al., 2014, Italy, cross-sectional	N= 100, 51%	47.7 years (SD= 12.9)	NR 19%	4 (5.6), 13.8 (12.7)	EDIS, bulimic behaviours	Group differences	0.76 [0.19 – 1.34]		medium	0.007*
Sacmaci and Gurel, 2019, NR, cross-sectional	N= 60, 50%	42.8 (13.1)	28.5 (4.7)	10.1 (9.7), 11.8 (8.1)	PSQI, subjective sleep quality	regression	0.55 [0.78 – 1.30]	-	medium	0.90
Cakmur and Dervis, 2015, Turkey, cross-sectional	N= 100, 50%	38.63	46% overweight	8.4 , 15.05 (10.36)	DLQI, QoL	BMI < 18 vs >30 BMI < 25 vs >30	0.27 [-0.91-0.365] 0.06 [-0.36 – 0.48]	-	Small weak	NR
Storer et al., 2018, USA, cross-sectional	N=47, 55%	51 (16)	100% obese	8.8 (8.2), NR	Based on Time (in years) to trade-off utility survey, QoL	correlation	.2 [CI- NR]	-	weak	NR
Bronckers et al., 2016,	N= 75, 29.3%	21.0 (8.0)	23.4 (6.9)	4.4 (4.9), NR	DLQI, QoL EQ-5D, QoL	correlation	DLQI EQ-5D -	.03 [CI- NR] .24 [CI- NR] -.26 [CI- NR]	weak small small	0.97 .04* .03*

Netherlands, cross-sectional					SF-36 Health Survey, QoL EQ-5D, QoL	regression	BMI was a significant predictor of quality of life			.001*
Barrea et al., 2016, Italy, case- control	N= 180, 71%	50	30.2 (SD= 6.1)	6 (range- 0.2- 28.8), NR	DLQI, QoL	Correlation BMI WC	- -	.24 [CI- NR] WC .26 [CI-NR]- WC, adjusted for BMI .09 [CI-NR]	small small weak	.001* .001* .26
Adawiyah, 2017, Malaysia, cross- sectional	N= 79, 0%	40.32 (10.0 4)	28.3 (5.51)	8.4 (range- 0.1-34.5), NR	MVFSFI, sexual dysfunction	Correlation	0.29 [0.12-2.38]	-	small	NR
Molina-Leyva et al., 2013, Spain, cross-sectional	N= 80, 50%	43.4 (12.7)	28.2 (6.7)	2.7 (range- 1.2-7.1), NR	MGH-SFQ, sexual dysfunction	Correlation	-	β = 0.9 [0.4 – 2.2]	large	.82
Remrod, 2013, Sweden, cross- sectional	N= 101, 55%	43.5 (13.8)	26.2 (4.5)	5.4 (4.3), NR	SUSP, personality traits	<i>correlation</i> Embitterment Irritability Mistrust Aggression	-	β =-0.3 [-0.6 - 0.1] β =.02 [-0.4 - 0.4] β =0.2 [-0.3 - 0.6] β = 0.3 [-0.1 - 0.8]	Weak Weak Weak Weak	.17 .92 .52 .17
Lewinson et al., 2017, Italy, retrospective	N= 73,447, 51%	Age range - 20- 90	NR 18.26%	>95% Mild psoriasis	MDDRC, depression	A lower proportion of patients with depression were obese (17.2%) compared to patients without depression (18.3%). Although the differences were significant (p<.0001), the % of non-obese was greater in the non-depressed group				
Kim et al., 2014, USA, cross- sectional	N= 114, 69%	47.7 years	NR 29.8%	10.2, 21.3	Single question items, anxiety, sexual relationship, sleep quality	Compared with normal weight patients, obese patients were more likely to perceive their general health as worse (p<.001), believed their psoriasis has caused weight gain (p=.015), view their weight as a problem (p<.001), experience sleep problems as a result of their psoriasis over lifetime (p=.01), hide their psoriasis over the last week (p=.02) and over lifetime (p=.001), have their self-confidence affected over the lifetime (p=.006) and over the last week (p=.02) as a result of psoriasis, avoid common activities as a result of psoriasis over lifetime (p=.011) and have used recreational drugs (p=.012).				
Tang et al., 2013, Malaysia, cross- sectional	N=250, 54%	42.5 (18- 83)	26.9 (SD=5.7) (26.8%)	9.9 (0.2- 69.2), 10 (0.5-49)	SF-12, mental HRQoL DLQI, QoL	Normal weight and overweight individuals with psoriasis scored equally on the mental health scale. Normal weight people with psoriasis and those with a BMI of more than 25 did not differ in terms of their mental health and quality of life.				

Ryan et al., 2013, Dallas, Texas, and Dublin, cross-sectional	N=354, 57.6%	48 (18-78)	NR	4.3 (0-44.8), NR	CES-D, depression DLQI, QoL RSS, relationship and sexual life	Conditional regression analyses were run and indicated that increase in BMI is associated with an increase in CES-D scores (p=.007). Conditional regression analysis indicated that increase in BMI is not significantly associated with an increase in DLQI scores (p=.439). Increase in BMI was significantly associated with a greater impairment in the relationship quality and sexual life of patients with psoriasis (p=.038)
Sanchez-Carazo et al, 2014, Spain, cross-sectional	N=1022, 60%	NR 26%	NR 26%	61% - mild, NR	SF-12, QoL	BMI was associated with a decreased physical health component (p<.05), but not with mental health component (p- not reported).

Note: NR- not reported; CI- confidence intervals; RCT- randomised-controlled trial QoL- quality of life; HRQoL- health-related quality of life; DLQI- Dermatology Quality of Life Index. PSQI- Pittsburgh Sleep Quality Index. EQ-5D- EuroQol- 5 Dimension. MGH-SFQ- The Massachusetts General Hospital-Sexual Functioning Questionnaire. MVFSFI- Malaya Version of Female Sexual Function Index. GHQ- General Health Questionnaire. EDIS- Eating Disorders Inventory Scale. PSQ- Patient Health Questionnaire. SUSP- The Swedish Universities Scale of Personality. SF-12- Short-Form-12 Health Survey; SF-36- Short-Form-36 Health Survey; BMI- body mass index; PASI- psoriasis area and severity index.

To date, most studies have focused on the relationship between weight-related outcomes and depression, and quality of life (QoL) among psoriasis patients (n=12), using BMI (n=18) and waist circumference (n=1) as outcome measures. Anxiety, sexual dysfunction, lifestyle factors, personality traits, beliefs and emotional regulation were less frequently examined factors in relation to weight outcomes.

Quality assessment

The quality of the studies (n=18) was assessed using Critical Appraisal Skills Programme (CASP, 2019). Four studies were rated as high quality, ten as moderate and four as low (Table S2; supporting information). The psychosocial variables included in each study and the calculated magnitude of the relationship between psychosocial factors to weight-related outcomes is available in Table 2 and discussed under the psychosocial sub groupings below.

Depression and anxiety

Six studies in total examined the association between BMI and depression: four cross-sectional (Cohen, Martires, & Ho, 2016; Innamorati et al., 2016; Kim et al., 2014; Ryan et al., 2015) one RCT (Tabolli et al., 2012) examining the baseline correlation, and one retrospective population-based study (Lewinson et al., 2017). Four out of the six studies found that patients with higher BMI reported significantly greater levels of depression (Cohen et al., 2016; Innamorati et al., 2016; Ryan et al., 2015; Tabolli et al., 2012). Effect sizes could be calculated for two of these studies. One showed a weak effect for the correlation between BMI and depression (Tabolli et al., 2012) and the other a large between-groups effect for the comparison between normal weight and obese patients (Cohen et al., 2016). Differences in the magnitude of the effect sizes can be attributed to the different ways used to approach the data- correlational versus group differences.

Of the two disparate studies, one reported comparable levels of depression between normal weight and obese patients (Kim et al., 2014). However, unlike the four studies above which used validated measures of depression, this study assessed depression with a single question, and the sample size was small. The other disparate study was a retrospective-population study which reported that non-obese people are more likely to be depressed than obese people (Lewinson et al., 2017). Missing data were more prevalent in the depressed than nondepressed group which somewhat undermines the association. The association between BMI and anxiety was explored in two studies (Innamorati et al., 2016; Tabolli et al., 2012). Both reported a significant positive association between higher BMI and increased anxiety.

Quality of Life (QoL)

Nine cross-sectional studies (Barrea et al., 2016; Bronckers, van Geel, van de Kerkhof, de Jong, & Seyger, 2019; Çakmur & Derviş, 2015; Grozdev et al., 2012; Innamorati et al., 2016; Ryan et al., 2015; Sanchez-Carazo, López-Estebanz, & Guisado, 2014; Tang, Chang, Chan, & Heng, 2013) and one RCT (Tabolli et al., 2012) examined the baseline association between BMI/obesity and QoL. Of these, seven studies reported negative associations between BMI and QoL (Barrea et al., 2016; Bronckers et al., 2019; Çakmur & Derviş, 2015; Grozdev et al., 2012; Innamorati et al., 2016; Storer, Danesh, Sandhu, Pascoe, & Kimball, 2018; Tabolli et al., 2012), and waist circumference and QoL (Barrea et al., 2016), indicating that higher BMI and waist circumference are linked to worse QoL. The magnitude of the associations was estimated to be weak to medium in most studies (Barrea et al., 2016; Bronckers et al., 2019; Çakmur & Derviş, 2015; Grozdev et al., 2012; Storer et al., 2018) and large using the RCT's baseline data (Tabolli et al., 2012). The RCT measured QoL using Skindex-29 (Tabolli et al., 2012), while the cross-sectional studies used the Dermatology Quality of Life Index (DLQI)

(Barrea et al., 2016; Bronckers et al., 2019; Çakmur & Derviş, 2015; Innamorati et al., 2016; Storer et al., 2018). Skindex-29 includes a wider range of emotional items which are addressed by a single item in the DLQI (F Sampogna, 2004). Similar findings were observed for QoL in one study where obese people with psoriasis were significantly more likely to report worse QoL than obese people without psoriasis (Innamorati et al., 2016). These findings differed in the rest of the cross-sectional studies which reported no association between BMI and QoL (Ryan et al., 2015; Sanchez-Carazo et al., 2014; Tang et al., 2013). Two of these studies (Ryan et al., 2015; Tang et al., 2013) had much larger cohorts of participants than the ones reporting a positive association (Barrea et al., 2016; Bronckers et al., 2019; Çakmur & Derviş, 2015; Grozdev et al., 2012; Innamorati et al., 2016; Storer et al., 2018; Tabolli et al., 2012).

Contrary to the above patterns, three of the studies that looked at mental health related QoL specifically in a sample of psoriasis patients found that higher BMI was associated with better mental health related QoL (Grozdev et al., 2012; Innamorati et al., 2016; Tabolli et al., 2012). One showed a weak effect (Grozdev et al., 2012), reporting a positive association (C. Ryan et al., 2015) and a large effect (Tabolli et al., 2012). These differences are perhaps due to the lack of acknowledging the U-shaped association between BMI and QoL observed in the general population, where underweight and obese patients are at highest risk of mental health problems (Dalle Grave, Sartirana, & Calugi, 2020; Luppino et al., 2010; Özsahin & Altintas, 2018; Ul-Haq, Mackay, Fenwick, & Pell, 2013) or as a result of measuring QoL without skin-specific tool such as DLQI.

Sexual dysfunction

Four cross-sectional studies (Adawiyah, 2017; G. Kim et al., 2014; Molina-Leyva, 2015; Ryan et al., 2015) investigated the association between BMI and sexual dysfunction. Of these, three (Adawiyah, 2017; Molina-Leyva, 2015; Ryan et al., 2015) reported a positive association between BMI and sexual dysfunction. The magnitude of the association was calculated as small (Adawiyah, 2017; Sacmaci, 2019) and large (Molina-Leyva, 2015). Conversely, Kim et al. (Kim et al., 2014) reported that the sexual functioning of obese and normal weight patients with psoriasis was comparable. However, unlike the other studies⁶, Kim et al. (Kim et al., 2014) used a non-validated measure of sexual functioning.

Lifestyle factors

Two cross-sectional studies (Cohen et al., 2016; Kim et al., 2014) looked at the association between BMI and lifestyle-related factors and reported medium positive associations between BMI and difficulty working, taking care of things at home, and getting along with people (Cohen et al., 2016). Obese people with psoriasis were significantly more likely to avoid common physical activities such as swimming and to use recreational drugs than normal weight people with psoriasis (Kim et al., 2014).

Furthermore, two cross-sectional studies (Adawiyah, 2017; Kim et al., 2014) were consistent in finding a high BMI was associated with more subjective sleep problems. One showed a medium positive association (Adawiyah, 2017) and the other reported that obese people with psoriasis had significantly more sleep problems than normal weight people with psoriasis (Adawiyah, 2017).

⁶ The Female sexual functioning index (Adawiyah, 2017), The Massachusetts General Hospital-Sexual Functioning Questionnaire (Molina-Leyva, 2015)

Personality factors, beliefs and emotional regulation

Four cross-sectional studies (Innamorati et al., 2016; Kim et al., 2014; Remröd, Sjöström, & Svensson, 2013; Sanchez-Carazo et al., 2014) looked into the association between BMI in psoriasis and personality factors, beliefs or emotional regulation. Of these, one study (Remröd et al., 2013) assessed the relationship between BMI and embitterment, trait irritability, mistrust and verbal aggression. The study reported weak positive correlations between BMI and these personality traits, except for embitterment where the association was small and negative (Remröd et al., 2013). Two of the other studies compared obese people versus healthy weight people with psoriasis (Cohen et al., 2016; Sanchez-Carazo et al., 2014). Kim et al. (2014) found that obese people with psoriasis had greater need to hide psoriasis, reported stronger beliefs that psoriasis caused weight gain, had lower self-confidence, and were more likely to perceive that weight is a problem in managing psoriasis than normal weight patients (Kim et al., 2014). Similarly, there were medium positive between-group differences for higher interoceptive awareness⁷ and bulimia, and small positive between-groups differences for higher interpersonal distrust⁸ and higher ineffectiveness⁹; all these factors were more common in obese people with psoriasis versus those with normal weight (Sanchez-Carazo et al., 2014).

One additional cross-sectional study (Ryan et al., 2015) looked at the differences between obese people with and without psoriasis and reported that obese people with psoriasis were

⁸ defined as confident negative expectations regarding one's conduct (Crosta et al., 2014)

⁹ defined as the quality of not producing any significant or desired results (Crosta et al., 2014)

significantly more likely to have severe alexithymia¹⁰, difficulties in emotional regulation, and food cravings versus those without psoriasis.

Discussion

This systematic review included 18 studies to examine the association between psychosocial factors and body weight in people with psoriasis. It was largely agreed that increasing weight is associated with higher rates of depression, anxiety, and poorer QoL. A small number of studies also showed a positive association between higher weight and poor subjective sleep quality, sexual dysfunction, and emotional regulation issues. The included studies were all cross-sectional. This precluded determining the direction of causality of the examined associations and highlighted the surprising lack of prospective studies. The understudied role of weight-specific cognitions such as self-confidence to engage in healthy behaviours and body image issues that are likely to affect the success of committing to weight-loss behaviours was also observed (Cohen et al., 2016; Dalle Grave, Sartirana, et al., 2020). One of the reviewed studies showed that beliefs that psoriasis caused weight gain was related to higher BMI (Cohen et al., 2016). Such beliefs may result in a fatalistic response to weight management and need to be explored further.

The findings from this systematic review are consistent with the literature in the general population which suggests that the rates of depression, anxiety and impaired QoL are significantly higher among obese individuals than those with normal weight (Luppino et al., 2010; Özsahin & Altintas, 2018; Pokrajac-Bulian, Kukić, & Bašić-Marković, 2015; Truthmann et al., 2017). The mostly weak to small magnitude of the associations between weight outcomes and psychosocial factors in psoriasis can be explained by several

¹⁰ defined as the inability to describe or define one's emotions (Innamorati et al., 2016)

methodological limitations. Males were over-represented in most of the included studies (Barrea et al., 2016; Innamorati et al., 2016; Kim et al., 2014; Sanchez-Carazo et al., 2014; Tabolli et al., 2012). There are well-documented gender discrepancies in the general obese population suggesting a significant association between obesity and poor mental health in females, but not males (Dalle Grave, Calugi, et al., 2020; Ul-Haq et al., 2013). Luppino et al. (2010) demonstrated almost a double risk for women with obesity to develop depression in comparison to men (67% and 31%, respectively). The included studies did not acknowledge these gender differences and no gender-stratified results were available. The majority of the included patients (n=13/18) had mild psoriasis (Adawiyah, 2017; Barrea et al., 2016; Bronckers et al., 2019; Çakmur & Derviş, 2015; Crosta et al., 2014; Innamorati et al., 2016; Lewinson et al., 2017; Molina-Leyva, 2015; Remröd et al., 2013; Ryan et al., 2015; Sanchez-Carazo et al., 2014; Storer et al., 2018; Tang et al., 2013). This limits the conclusions about the relationship between mental health and weight as obesity is more prevalent among patients with severe psoriasis phenotypes than milder ones (Mahil et al., 2019).

Furthermore, the included studies did not investigate the curvilinear relationship between BMI and the risk of depression and poor mental health that has been demonstrated in the general population; where underweight (BMI <18.5 kg/m²) and severely obese (BMI of ≥ 40 kg/m²) are the most strongly correlated with depression and poor mental health (Dalle Grave, Calugi, et al., 2020; Jung & Luck-Sikorski, 2019; Luppino et al., 2010; Ul-Haq et al., 2013). Most studies (n=17/18) looked at BMI as a continuous variable and the average BMI of their samples fall in the overweight category. The studies that dichotomised participants into non-obese and obese used the cut-off points with a very close proximity. Thus, individuals close to but on the opposite side of the cut-off point are characterised as being very different rather than very similar. Excess body weight in all studies was based on BMI which does not

completely reflect trends in body fat (Flegal et al., 2009). Whole-body fat mass, but not whole-body non-fat mass, causes depression (Sorokin et al., 2018). Therefore, more sensitive tools for measuring adiposity such as waist circumference are needed to determine the strength of the association with psychosocial factors.

Beyond the role of depression, anxiety, and QoL, cognitive factors such as beliefs, thinking styles, and body-image issues were largely overlooked. Approaches that address cognitions can outperform the outcomes achievable by traditional lifestyle-modification weight-loss treatments (Dalle Grave, Calugi, Gavasso, El Ghoch, & Marchesini, 2013). Since people with obesity and psoriasis are likely to have low self-confidence and body image issues particularly related to their skin condition, these can be important processes maintaining unhealthy weight through behavioural withdrawal and inactivity (Cohen et al., 2016). Yet, so far only traditional approaches have been used in psoriasis that overlook patients' weight-specific beliefs (Mahil et al., 2019). One reviewed study suggested that addressing beliefs about the relationship between psoriasis and weight may also be important (Cohen et al., 2016). Thus, future research should combine traditional behavioural techniques aimed at facilitating weight loss with cognitive techniques such as addressing negative body image to reduce weight-loss treatment attrition and increase weight loss and weight maintenance behaviours (Dalle Grave, Calugi, et al., 2020; Dalle Grave, Calugi, & Marchesini, 2014).

Limitations

The review was limited to adults and findings cannot be generalised to paediatric populations. There was variability in measures of psychosocial factors which limits comparisons between studies. The focus on bivariate analyses and dichotomized multiple between-group analyses to facilitate comparison across studies may have limited an in-depth understanding of

psychosocial factors based on multivariable models and more subtle subgroup analyses.

Given the exclusively cross-sectional nature of the evidence depression anxiety, and impaired QoL are likely to also be consequences of excess weight.

Conclusion

This systematic review highlighted the multifaceted nature of excess weight in psoriasis and its positive association with worsen psychosocial outcomes that should be addressed as part of tailored weight-loss treatment approaches. Future studies should include the following: (1) explore gender subgroup differences and present stratified results; (2) conduct well-designed longitudinal cohort studies which include people with severe psoriasis to test the relationships between psychosocial factors and weight outcomes, ideally using more fat-sensitive measures such as waist circumference; (3) conduct qualitative research to explore the understudied experiences of weight management of obese patients with psoriasis; (4) use theory-based approaches to select psychosocial factors associated with obesity to build a better understanding of obesity in the context of psoriasis, subsequently leading to theory- and evidence-based tailored interventions that are likely to achieve better and lasting clinical outcomes.

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END OF PUBLISHED ARTICLE

3.3. Concluding remarks

The evidence of the psychosocial factors of obesity in psoriasis is limited, based on the findings from the systematic review. Studies that explored these factors did not use theory-based approaches to select them. The Medical Research Council (MRC) framework for designing complex interventions states that factors included in an intervention design should be both theory and evidence driven (Skivington et al., 2021). The exploration of the theoretical approaches relevant to obesity in the context of psoriasis would be the first step towards the selection of the psychosocial factors that may be associated with body weight in psoriasis for consideration in future tailored behavioural based intervention for weight loss in psoriasis. The next chapter will focus on the reviewing relevant theoretical evidence to the context of obesity in psoriasis.

Chapter 4: Theoretical underpinnings of the thesis

4.1. Chapter overview

The previous chapter synthesised existing evidence on the role of psychosocial factors in body weight in psoriasis. The evidence to date has focused predominantly on depression or anxiety and any other factors were rarely selected in consideration of theories. The associations between depression or anxiety with high body weight in psoriasis were mixed and predominantly null or weak. These findings suggested that other cognitive (e.g., illness perceptions) and behavioural (e.g., emotional eating) factors which were currently overlooked in the review may be better at explaining weight outcomes in psoriasis (Pavlova et al., 2021). It is also possible that high body weight is driven by how people manage their negative affect (e.g., depression and anxiety) rather than the actual experiences of such an affect (Katona, 2000). Findings from the general literature indicated that emotional eating is common in people with obesity (van Strien, Herman, & Verheijden, 2012) and may moderate the association between depression and body weight (Goldschmidt, Crosby, Engel, et al., 2014; Konttinen, Männistö, Sarlio-Lähteenkorva, Silventoinen, & Haukkala, 2010; Konttinen, Silventoinen, Sarlio-Lähteenkorva, Männistö, & Haukkala, 2010; van Strien et al., 2016), yet its relevance in psoriasis is unknown. In the context of obesity as a comorbid condition in psoriasis, it also seems important to consider people's perceptions of the skin condition and the potential relevance of these to weight-loss related behaviours (Hagger & Orbell, 2003; Petrie, Jago, & Devcich, 2007).

Exploration of psoriasis-specific cognitions and behaviours may facilitate the understanding of why people may or may not be able to engage in weight loss behaviours (Phelan et al., 2009; Silva et al., 2011). Psychological theories can be particularly helpful to explain weight

loss related aspects and behaviours (Markey, August, Bailey, Markey, & Nave, 2016). Based on the findings from the systematic review, none of the included studies selected the investigated psychosocial factors potentially relevant to obesity based on theory, despite that theoretical approaches have been established as important for solving clinically relevant problems such as obesity (Bartholomew & Mullen, 2011). Theoretical knowledge is crucial for designing tailored illness-specific weight-loss interventions for optimising patients' outcomes (Clark et al., 2004; Peckmezian & Hay, 2017b).

Together these findings set up the objectives of the current chapter. The primary focus of this chapter is to review relevant theoretical approaches that may be underlying unhelpful weight loss management behaviours such as emotional eating. In particular, the discussion will focus on theories of emotional eating (Affect Regulation Theory (Kaplan & Kaplan, 1957) and Escape Theory (Heatherton & Baumeister, 1991) arguing that eating serves as an affect regulator for decreasing negative affect. As discussed in Chapter one, people with psoriasis face several idiosyncratic psychosocial challenges which may trigger negative affect. The common comorbid obesity (discussed in Chapter two) may add additional burden on people's lives further exacerbating the experienced negative affect. Therefore, it is important to consider the theory-driven underlying mechanisms of affect management and its potential link to weight loss related behaviours to better understand the needs of people living with psoriasis.

To integrate the context of psoriasis, the Common-Sense Model of Self-Regulation (CSM-SR) will be considered as a relevant framework for the theoretical underpinnings of this thesis (Leventhal et al., 1997). Cognitive factors (e.g., illness perceptions) related to how people view their psoriasis may directly influence coping behaviours (e.g., how people cope

with their psoriasis) (Leventhal, Phillips, & Burns, 2016). Both illness perceptions and coping behaviours have previously emerged as important weight loss determinants (Kim et al., 2014). The investigation of the cognitive and behavioural factors, from the perspective of the CSM-SR, may help to explain engagement or disengagement in required weight loss behaviours, especially given the scarcity of psoriasis studies that focused on cognitive factors (Pavlova et al., 2021).

The consideration of Affect Regulation Theory, Escape Theory, and CSM-SR was made over the inclusion of other theories due to the fact that all these three theories may help to explain the connection between cognitive, emotional, and behavioural factors in relation to body weight outcomes in psoriasis and reveal the underlying mechanisms of this connection. All these three theories have been extensively evaluated and applied to the context of obesity management (Haedt-Matt et al., 2014; Spoor, Bekker, Van Strien, & van Heck, 2007) and chronic conditions (Hagger, Koch, Chatzisarantis, & Orbell, 2017; Hagger & Orbell, 2003; Leventhal et al., 2016), making them particularly relevant to the aims of this thesis.

4.2. Definitions of emotional eating

Emotional eating is defined as “the tendency to overeat in response to negative emotions such as anxiety or irritability” (van Strien & Bazelier, 2007) (p.106). In the general literature, emotional eating has been associated with obesity (Koenders & van Strien, 2011) and there is an increasing number of people who report emotionally-biased eating patterns (Reichenberger, Schnepfer, Arend, & Blechert, 2020). Emotional eating occurs in stressful situations or in response to threatening information, regardless of physical sensations such as hunger and satiety (Bruch, 1964). People who eat emotionally use food to control their mood during times of negative affect (van Strien et al., 2012; van Strien & Ouwens, 2007).

Emotional eating can be triggered by physical (e.g., pain), situational (e.g., food availability) and emotional factors (Kontinen, 2020) (e.g., stress (Tan & Chow, 2014), exhaustion (Zeeck, Stelzer, Linster, Joos, & Hartmann, 2011), and embarrassment (Wong & Qian, 2016)). The diversity of triggers suggests that the experiences of emotional eating may vary between people. All of these triggers, including embarrassment and physical symptoms such as pain or itch, are particularly relevant to psoriasis, as discussed in Chapter one.

Research on emotional eating was initially conducted as an attempt to understand obesity (Faith, Allison, & Geliebter, 1997; Ganley, 1989). Emotional eating has been referred as an important predecessor to the rising rates of obesity and is considered to play an important role in the aetiology of obesity (Jáuregui-Lobera & Montes-Martínez, 2020). Overconsumption of food without compensatory increased physical activity resulted in epidemic proportions of obesity and significant healthcare implications in the United Kingdom (Scholtz & Morgan, 2009). Therefore, several theories are used to provide a distinctive perspective, outlining the complexity of emotional eating.

Theories of self-regulation suggest that shortages in the self-regulation system can negatively challenge daily functioning. Self-regulation is a process through which people use control over the self to reach a goal or a need (Vohs & Baumeister, 2011). Previous studies proposed that eating can become a function of emotional or affect regulation rather than a response to physiological hunger (Stroebe, 2022). The Affect Regulation Theory (Kaplan & Kaplan, 1957) suggests that emotional eating serves to alleviate negative affect (Spoor et al., 2007). Escape Theory (Heatherton & Baumeister, 1991) builds on this idea and proposes that emotional eating is not only motivated by the desire to escape from the negative emotions, but also helps people to escape self-awareness by diverting attention from the stimuli that

trigger negative affect to focus on more pleasing activity like eating (Spoor et al., 2007). Both models are further discussed below.

4.3. A description of Affect Regulation Theory (ART)

Affect or emotional regulation refers to the underlying mechanisms through which people express and experience their emotions (Gross, 1999). The pursuit of affect regulation is to achieve affective equilibrium that maintains physical and mental health (Gross, 1999). On the other hand, emotional regulation difficulties have been associated with impaired physical and psychological health (Gross, 2015). Gross (1998) suggested that there are two types of affect regulation strategies: antecedent-focused emotional regulation (e.g., cognitive reappraisal) and response-focused emotional regulation (e.g., expressive suppression) (Gross, 1998). Cognitive reappraisal is defined as the effort to re-interpret a situation that elicits strong emotions in a way that affects both the situation's meaning and its emotional impact (Gross, 1998). Expressive suppression is defined as the act of attempting to suppress, prevent, or lessen the emotions that arise from emotionally challenging circumstances (Gross & John, 2003). Naturally, the effects of these self-regulation strategies vary. Cognitive reappraisal is associated with fewer negative emotions as it allows people to distance themselves from the difficult situation and reappraise it which may positively alter their physiological and behavioural responses (Mischel & Ayduk, 2004). Conversely, expressive suppression decreases emotional expression which has been linked to symptoms of depression and impaired self-esteem and quality of life (Gross & John, 2003; John & Gross, 2004). People may use food as a method for dealing with adverse emotional experiences by directly suppressing them through food, suggesting that emotional eating may present as an expression suppression strategy.

Affect Regulation Theory (ART) is based on the psychosomatic theory (Allison & Heshka, 1993), aligning with the notions that emotional eating functions as a form of emotional regulation (Gross, 1999). ART proposes that emotional eating is driven by the desire to escape from the negative emotions, and may become a conditioned response to heightened negative mood (Gross, 1999). ART does not explain the affective experiences during an eating episode, but rather focuses on the affective predecessors and consequences of emotional eating. Negative emotional states are assumed to trigger episodes of emotional eating which is used to alleviate the negative emotions such as depressive mood, anxiety, and loneliness (Gross, 1999), thereby providing negative reinforcement for engaging in future emotional eating behaviours with the purpose to manage affect (Canetti, Bachar, & Berry, 2002).

Several empirical studies applied the ART within clinical and research fields in the context of emotional eating. Eating has been suggested to serve as an affect regulator and to decrease the negative emotions in clinical (Arnold, Kenardy, & Agras, 1995; Heatherton & Baumeister, 1991; Kenardy, Arnold, & Agras, 1996; Polivy & Herman, 1993) and non-clinical populations (Stice, Ziemba, Margolis, & Flick, 1996). Despite the consistent findings, these studies did not explain the duration of the decreased negative affect following eating. It is unclear if the negative affect decreases immediately after the episode of emotional eating or potentially increases across longer timespans. There is evidence to suggest that while negative affect decreased in hours following eating (Becker, Fischer, Crosby, Engel, & Wonderlich, 2018; Berg et al., 2017), it remained elevated over baseline (Berg et al., 2017; Munsch, Meyer, Quartier, & Wilhelm, 2012), and emotional eating on day one may be predictive of higher negative affect on the next day (Barker, Williams, & Galambos, 2006; Haedt-Matt et al., 2014). Moreover, the studies using ART did not highlight the underlying

mechanisms of actioning an 'escape' from the negative affect. Distraction can be one of the ways which people use food to escape from the negative affect. Distracting from the negative emotions is based on the idea that expressing the affect will result in negative outcome, whereas emotionally distracting from the situation with food may lessen the negative affect (Fonagy, 2001; Fraley & Shaver, 2000) and even trigger self-soothing sensations (Clinton, 2006), further reinforcing the desire to use food to self-sooth. The Escape Theory proposes that distraction is the primary process that underlies emotional eating behaviours (Heatherton & Baumeister, 1991). Escape Theory also suggests that the negative affect before and after the emotional eating episode are at its highest, whereas a decrease in negative emotions is observed during the eating episode (Mikhail, 2021). Escape Theory is a continuation of the ART and is discussed below.

4.4. A description of Escape Theory (ET)

The escape theory (ET) proposes that emotional eating in response to negative affect is an attempt to escape or distract from the negative stimuli that cause an unwanted self-awareness (Heatherton & Baumeister, 1991). When faced with an adverse situation or information, people aim to escape from their self-awareness with the purpose to stay away from the unwanted implications and associated negative emotions. People try to escape by focusing their attention on an external stimulus such as food, that may ultimately drive emotional eating (Heatherton & Baumeister, 1991). Emotional eating may be a distractor from the original stressor or source of distress (Polivy & Herman, 1993), decreasing the attention paid to the adverse stimulus and reducing the negative affect while eating is in progress. However, after the episode of eating finishes, the levels of negative affect resume back to baseline (Heatherton & Baumeister, 1991). Although the empirical evidence agrees with the fact that food may decrease negative affect while eating is in progress, studies have suggested that

negative affect immediately before eating is lower than the negative affect after eating (Alpers & Tuschen-Caffier, 2001; Goldschmidt, Crosby, Cao, et al., 2014; Steiger et al., 2005). The elevation in the negative affect after eating as compared to baseline further indicates that emotional eating is a consequence of unhelpful coping strategies used to manage difficult emotional situations. Coping methods can be defined as the process of managing stressful demands or associated negative emotions (Folkman & Lazarus, 1985). Three different coping methods have been suggested: problem-focused, emotion-oriented, and avoidance coping (Endler & Parker, 1994). Problem-focused coping is used to alter the situation to reduce the amount of stress it evokes. In emotion-oriented coping, attempts are directed towards reframing the problematic situation or changing the emotional responses to a stressor. Avoidance-oriented coping such as actively avoiding an existing situation and denying its existence through engaging in unrelated activities aims to serve as a distractor to reduce stressful experiences and associated emotions (Endler & Parker, 1994; Folkman & Lazarus, 1985).

The ET proposes that people engage in avoidance-oriented coping to distract from present stressful situations or negative emotions. Several studies suggested that avoidance by distraction is associated with disordered eating, including frequent emotional eating (Ball & Lee, 2002; Denisoff & Endler, 2000; Fitzgibbon & Kirschenbaum, 1990; Freeman & Gil, 2004). Together this evidence contributes to the assumption that in the presence of negative affect people may lack sufficient coping resources to regulate their emotions and instead turn to employ accessible but not necessarily helpful coping methods such as eating (Evers, de Ridder, & Adriaanse, 2010; Evers, Marijn Stok, & de Ridder, 2010). In the long-term, such behaviours have been positively associated with negative physical (e.g., obesity) and psychological consequences (e.g., depression) (Billings & Moos, 1984; Faith et al., 1997;

Haslam, Jetten, Postmes, & Haslam, 2009; Marx, Williams, & Claridge, 1992; McWilliams, Cox, & Enns, 2003). Thus, emotional eating is not only linked to the experience of negative affect itself, but also to the lack of sufficient coping and emotion regulation strategies used to reduce the negative affect (Spoor et al., 2007).

4.5. Critical appraisal of theories of emotional eating

Studies on emotional eating are mostly quantitative and primarily investigated the relation between negative affect and emotional eating. Findings confirmed that negative emotions and thoughts may lead to uncontrolled cycle of eating and negative emotions (Ouwens, van Strien, & van der Staak, 2003). The association between negative affect and emotional eating is likely bidirectional such as mood may affect food consumption and food consumption may affect mood (Gibson, 2006). Yet theoretical and empirical evidence is primarily based on the assumption that negative affect is a predecessor of emotional eating which may then drive further negative affect.

Both ART and ET propose that emotional eating is used by people to alleviate negative affect and adverse self-awareness. Spoor et al. (2007) provided an alternative explanation postulating that emotional eating is a consequence of insufficient abilities to cope with the negative affect and adverse self-awareness (Spoor et al., 2007). Research also indicated that self-reported overeating was not a predecessor of objective emotional eating (Evers, Marijn Stok, et al., 2010). People who perceived themselves as emotional eaters did not consistently increase their food consumption when experiencing negative affect (Evers, Marijn Stok, et al., 2010). Some studies have observed that self-reported emotional eaters consumed more food than non-emotional eaters (O'Connor, Jones, Conner, McMillan, & Ferguson, 2008; Oliver, Wardle, & Gibson, 2000), whereas other studies did not make these observations

(Conner, Fitter, & Fletcher, 1999; Evers, de Ridder, & Adriaanse, 2009; Evers, de Ridder, et al., 2010).

The lack of uniformity in the empirical findings in relation to emotional eating is possibly because of the potential involvement of further variables. For example, studies have clearly indicated gender differences in using emotional eating as an emotion regulation strategy.

When compared to men, women were found to use more emotion regulation strategies (Stanton et al., 2000) as a result of being more emotionally expressive (Brebner, 2003) which makes them more prone to emotional eating (Van Strien, Engels, Van Leeuwe, & Snoek, 2005). Although women have shown higher emotional eating tendencies, it may be that men are less likely to report or self-identify themselves as emotional eaters (Zellner et al., 2006).

The presence of medical conditions may also play a role in the observations made in relation to negative affect and emotional eating. Most people living with obesity (60-90%) eat in response to negative emotions such as sadness, boredom, and anger (Ganley, 1989). The presence of other medical conditions such as psoriasis may further exacerbate the negative affect and predispose people to use emotional eating as a self-regulation strategy to manage psoriasis associated burden (Chisholm et al., 2016). Therefore, it is important to emphasise on the complexity of emotional eating, considering individual differences and medical conditions. To integrate the context of psoriasis, the Common-Sense Model of Self-Regulation (CSM-SR) was considered as an additional concept underlying the theoretical underpinnings of this thesis.

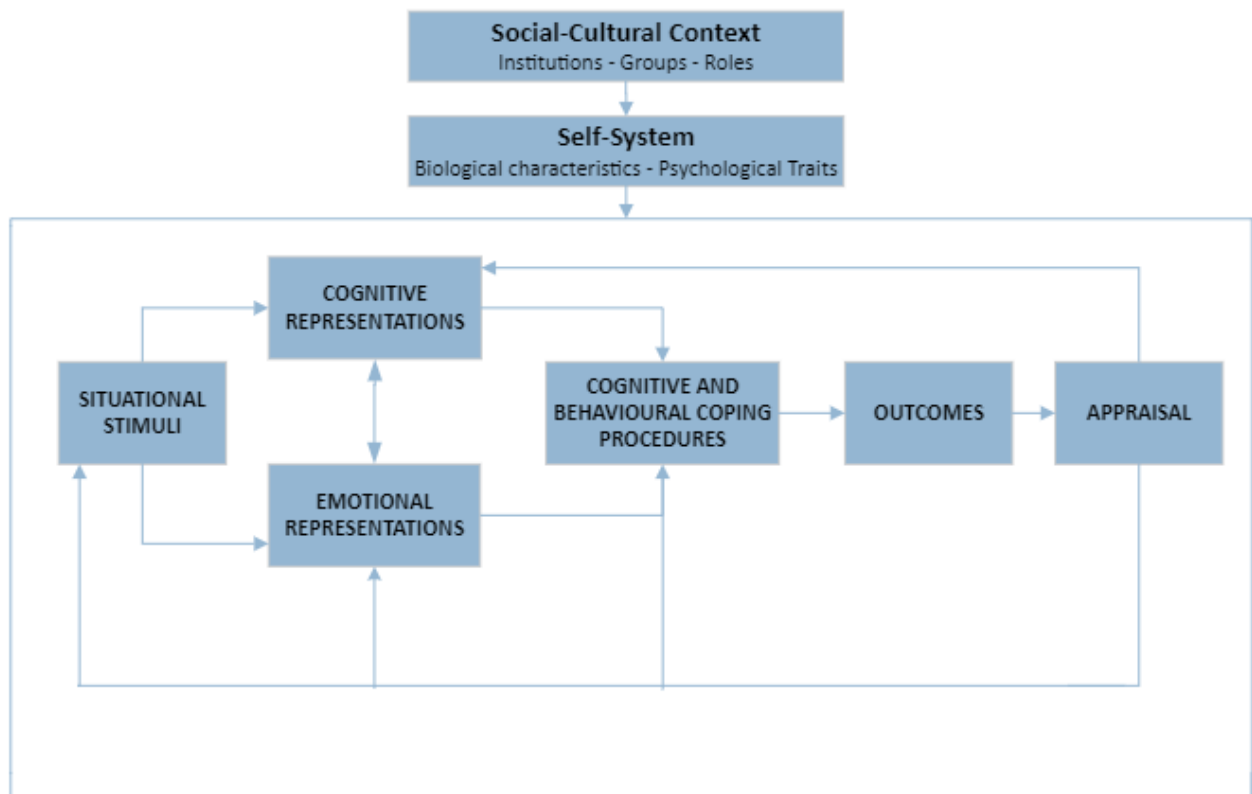
4.6. A description of the Common-Sense Model of Self-Regulation (CSM-SR)

The Common-Sense Model of Self-Regulation (CSM-SR) is a self-regulation model, similarly to the models discussed above, which suggests that a health threat (such as a

diagnosis or associated symptom(s) may disturb physical and psychological equilibrium which motivates people to engage in behaviours to restore their equilibrium (Cameron & Leventhal, 2003). CSM-SR suggests that self-regulation is a dynamic process that includes interpretation, coping and appraisal (Brissette, Leventhal, & Leventhal, 2003). Interpretations arise through diagnosis or symptoms perceptions which are interpreted based on internal (e.g., beliefs) and external stimuli (e.g., doctor's opinion).

The model suggests that when people are given a diagnosis (e.g., psoriasis) or experience symptoms or signs of disease (e.g., a psoriasis flare), they form lay interpretations that may impact the choice of self-management behaviours (Cameron & Leventhal, 2003). Psoriasis or a psoriasis flare can be interpreted through two parallel pathways: (i) cognitive representations and (ii) emotional representations. These mobilise coping strategies to self-regulate or manage the psoriasis threat and related emotional responses (Figure 4). Similar, to the theories of emotional eating discussed above (e.g., ART and ET), CSM-SR also emphasises the problem-focused and avoidance-oriented copings in the context of self-managing a diagnosis or associated symptoms; such as problem-focused coping would result in active seeking of medical advice to manage a diagnosis or associated symptoms, whereas avoidance-oriented would result in the denial of diagnosis or associated symptoms and avoidance of seeking help. Once coping strategies are adopted, people would appraise if equilibrium has been recovered and the extent to which applied coping strategies were successful. The consideration of successful coping strategies would determine if they need to be changed or maintained (Brissette et al., 2003).

Figure 4. *Graphical representation of the Common-Sense Model of Self-Regulation (CSM-SR)*



Note: Based on Leventhal et al.'s (1992, p.147) illustration (Leventhal, Meyer, & Nerenz, 1980)

4.6.1. Emotional representations

Emotional representations are referring to the emotional response that arises as a result of a diagnosis (e.g., psoriasis) or associated symptoms (e.g., psoriasis flare). Emotional representations have been suggested to have a crucial role in self-management behaviours and are also known to interact with illness representations (Mora, Robitaille, Leventhal, Swigar, & Leventhal, 2002). However, their interaction is not necessarily in a compatible way. For example, people may be aware of the collective symptoms being potentially indicative of a diagnosis, however, emotional responses such as fear may prevent them from seeking medical help (Martin, Rothrock, Leventhal, & Leventhal, 2003). These findings emphasise the need to gain a comprehensive understanding of relevant illness representations and their interaction with the emotional representations which may subsequently guide coping behaviours (Leventhal, Diefenbach, & Leventhal, 1992). As discussed earlier,

emotional eating may be used as a self-regulatory coping strategy to manage negative affect which may be attributed to emotional representations of psoriasis (e.g., embarrassment) and associated physical symptoms (e.g., pain and itch). These links are further discussed in the subsequent sections.

4.6.2. Illness representations

Cognitive representations are organised frameworks regarding a specific health condition (e.g., psoriasis). They support the interpretation of health threat-related information and alongside emotional representations determine coping behaviours and processes undertaken in response to the threat (Leventhal et al., 1997). Cognitive representations in the original model include five subcomponents or dimensions: identity, cause, consequences, timeline, and cure/control. These subcomponents are operationalised using the Illness Perceptions Questionnaire (IPQ) (Moss-Morris et al., 2002) (detailed overview of the revised version of IPQ, IPQ-R, is available in Chapter five). The aspect of *identity* includes how symptoms are experienced and recognised as relevant to the illness (e.g., psoriasis). *Cause* refers to the factors perceived to cause the illness or flare up of symptoms. For example, in psoriasis, stressful life experiences are often seen by people as a key main trigger for psoriasis onset and flare-ups (Fortune, Richards, Griffiths, & Main, 2002; O'Leary, Creamer, Higgins, & Weinman, 2004; Rousset & Halioua, 2018) which may not necessarily be medically relevant. *Consequences* aspect captures people's beliefs about the impact of their illness on life quality. *Timeline* dimension refers to the beliefs about the duration of the diagnosis or its associated symptoms, whether it is cyclical, chronic or acute. *Cure* and *control* aspects capture people's beliefs in relation to the curability of their illness and the extent to which they believe they can control their illness.

Following the development of the original IPQ (Weinman, Petrie, Moss-Morris, & Horne, 1996) to capture concepts relevant to the CSM-SR in chronic illnesses, some extensions and clarifications were made to the dimensions in the Revised version. '*Illness coherence*' was added to the model to include people's overall sense of understanding their illness (Moss-Morris, Chalder, Skerrett, & Baldwin, 2009; Moss-Morris et al., 2002). *Illness coherence* is particularly important since social interactions, such as with healthcare professionals, may all influence how well an illness is understood (Leventhal et al., 1992). Other factors that influence the formation of illness representations may include previously acquired information or actual experiences related to the diagnosis or its associated symptoms (Leventhal et al., 1980).

Timeline and *control dimensions* were also expanded (Moss-Morris et al., 2002). *Timeline cyclical* acknowledges the beliefs that the illness will go through cycles of exacerbation (e.g., flare ups) and remission. The *cure* and *control* dimension was split into two components - '*treatment control*' and '*personal control*', as psychometric evidence was indicative of two separate latent constructs only weakly correlated (Moss-Morris et al., 2002). *Treatment control* is focused on the beliefs about the helpfulness of illness or symptom related management advice. Whereas *personal control* is concerned with the perceived personal ability to control the illness or associated symptoms (Moss-Morris et al., 2002). Both higher treatment and personal control have been associated with greater adherence to weight loss behaviours, including physical activity and health eating, among people with chronic illnesses (Broadbent, 2010; Broadbent, Donkin, & Stroh, 2011; Broadbent, Ellis, Thomas, Gamble, & Petrie, 2009; Keogh et al., 2007; Petrie, Cameron, Ellis, Buick, & Weinman, 2002; Petrie et al., 2007), yet these remain unexplored in psoriasis.

4.6.3. Coping procedures

As discussed earlier, coping methods can be defined as the process of managing stressful demands or associated negative emotions (Folkman & Lazarus, 1985). The CSM-SR adds onto the previous discussion with the assumption that coping procedures are driven by cognitive and emotional illness representations and have an associated outcome and timeline expectations (Leventhal et al., 1997; Leventhal, Leventhal, & Contrada, 1998). If expectations are not met on time, updated cognitive and emotional representations will be triggered to reflect the threat (Kirmayer, Young, & Robbins, 1994). In the context of CSM-SR, coping procedures are mainly applied to reduce illness-associated stress rather than negative affect and situational stress that is the main scope of the emotional eating theories discussed above. The types of coping methods remain the same: problem-focused, emotion-oriented, and avoidance coping (Endler & Parker, 1994).

The impact of coping mechanisms on health outcomes varies depending on the situation (Leventhal et al., 1992). A meta-analysis indicated that problem-focused coping was linked to better health outcomes, whereas emotion-oriented and avoidance coping styles were linked to worse health outcomes (Penley, Tomaka, & Wiebe, 2002). However, moderation studies found that whether a coping strategy is adaptive or unhelpful is dependent on the type of health outcome (physical or mental health), as well as the stressor's features, including the type of stressor, length, and controllability (Penley et al., 2002). For instance, for controllable stressors, distancing was significantly associated with poorer health outcomes, but not for uncontrollable stressors (Penley et al., 2002), demonstrating that coping strategies are not inherently adaptive or unhelpful, but rather are subject to situational variability.

Because the majority of studies in this area have looked at general coping strategies rather than illness- or behaviour-specific coping strategies, not all feasible coping processes related

to an illness or symptoms are likely to be known (Hagger et al., 2017). Furthermore, present methods are unlikely to capture all potential coping mechanisms (Ridder, 1997). Given the complex, diverse, and dynamic character of coping which is based on the interaction between personal and situational circumstances, operationalising this concept has proven difficult, posing a barrier to developing a comprehensive knowledge of the role of coping procedures in mental and physical health (Oakland & Ostell, 1996; Parker & Endler, 1992; Ridder, 1997).

4.6.4. Appraisal of coping procedures

The CSM-SR also includes an important feedback loop, in which coping procedures are assessed (i.e., appraised) for their usefulness and applicability in restoring or protecting a state of health. Based on the appraisal outcome, currently used coping strategies are either maintained or changed (Leventhal et al., 1997). Although appraisal is a key component of the CSM-SR and appears frequently in qualitative studies, it is rarely studied in quantitative research and was only recently operationalised in relation to non-pharmacological treatment adherence (Bishop, Yardley, & Lewith, 2008). The following characteristics of adherence appraisal were derived from prior research and qualitative work with patients receiving non-pharmacological treatments: perceptions of symptom change, consultation experiences, including opinions about the therapist's skill and characteristics, and practical aspects of care, such as cost and accessibility (Yardley, Sharples, Beech, & Lewith, 2001). A positive evaluation of the therapist and the therapy offered did predict appointment attendance, suggested lifestyle changes, and use of supplemental therapy remedies when combined with cognitive representations and treatment beliefs (Bishop et al., 2008). Positive illness perceptions and treatment beliefs also adherence to complementary treatments (Bishop, Yardley, Cooper, Little, & Lewith, 2017). Early symptom changes, on the other hand, did not

predict attendance (Bishop et al., 2017). Despite these important observations, appraisal has yet to be operationalised outside of the adherence context. Such future knowledge would provide information on how people make decisions based on the outcomes of their coping behaviours (Leventhal et al., 1997).

4.7. Common Sense Model of Self-Regulation and psoriasis

The CSM-SR has been valuable to understanding some psoriasis-related outcomes (Fortune et al., 2002; Fortune, Richards, Griffiths, & Main, 2004; Fortune, Richards, Main, & Griffiths, 2000) and to explore the perceived experiences of people living with psoriasis (Henry, Bundy, Kyle, Griffiths, & Chisholm, 2019; Thorneloe, Bundy, Griffiths, Ashcroft, & Cordingley, 2017). This quantitative and qualitative evidence will be reviewed below.

Cross-sectional investigations explored associations between illness perceptions and coping strategies with variety of physical (e.g., psoriasis severity) and psychological variables (e.g., worry, depression, and psoriasis-related stress) (Fortune et al., 2002; Fortune et al., 2000).

The beliefs that psoriasis has serious consequences on patients' lives were the main predictors of worrying (Fortune et al., 2002; Fortune et al., 2000), depression and psoriasis-related stress (Fortune et al., 2002). On another hand, illness-related variables such as psoriasis severity and beliefs of cure and control of psoriasis were not associated with worrying (Fortune et al., 2002; Fortune et al., 2000). The clinical severity of psoriasis was associated with psoriasis-related disability only, and not with psoriasis-related stress (Fortune et al., 2002); findings that align with previous meta-analytical evidence across chronic illnesses (Hagger et al., 2017). The absence of a relationship between psoriasis severity and psoriasis-related stress might be due to the differences in perceptions. People living with psoriasis may be more likely to experience anxiety when in social situations due to their own

perceptions of the skin disease and also perceived assumptions of how others may see them rather than the actual psoriasis severity (Fortune et al., 2000).

Patients with psoriasis who feel they can manage the effects of their illness may not always be able to transfer their conviction or purpose into real adaptive behaviours. However, emotional experiences and concerns in relation to psoriasis may jeopardise their ability to put the belief that they can keep psoriasis in control into practice (Fortune, Main, O'Sullivan, & Griffiths, 1997). Previous research has found that one of the most important aspects of worry is that it prevents patients from brainstorming potential solutions to (i.e., problem-focused coping), arriving at and making a choice, and implementing a follow-up action plan (Ren et al., 2020). Greater worrying and anxiety are positively associated with avoidance- and emotional- focused coping; and negatively associated with problem-focused coping in psoriasis (Fortune et al., 2002). As mentioned in the section on *coping procedures* above, a meta-analysis indicated that problem-focused coping was linked to better health outcomes, while emotion-focused coping was linked to worse health outcomes across chronic conditions (Penley et al., 2002).

Qualitative evidence also suggested that emotion-focused coping has been linked to sleep disturbance among seventeen people living with psoriasis (Henry et al., 2019). In the study, people with psoriasis expressed a perceived loss of control which maintained arousal and negative thinking that led to compromised sleep quality (Henry et al., 2019). Such emotion-focused coping may maintain the negative affect (Harvey & Payne, 2002; Schmidt, Harvey, & Van der Linden, 2011) and ultimately lead to worse health outcomes (Penley et al., 2002), including exacerbated psoriasis symptoms (Hirotsu, Rydlewski, Araujo, Tufik, & Andersen, 2012). Increased arousal and the lack of appropriate coping methods may cause attention to

be drawn towards illness symptoms, increasing people's cognitive burden (Espie, Broomfield, MacMahon, Macphee, & Taylor, 2006).

Similar findings were observed in another qualitative study among 20 people living with psoriasis focused on people's illness perceptions and beliefs in treatment decision making and adherence to psoriasis treatment (Thorneloe, Bundy, Griffiths, Ashcroft, & Cordingley, 2013). The study suggested that medication underuse and overuse are influenced by different perceptions regarding psoriasis and psoriasis treatment. Concerns about potential side effects, perceived inadequate control of symptom management, and anxiety, all tended to contribute to medication underuse. Experiences of unexpected flares during drug use, judgments of questionable treatment efficacy, and dissatisfaction, all affected medication overuse. These findings implied that non-adherence to psoriasis medicine is a result of depleted personal resources and competing demands or priorities, all of which are different facets of self-regulation failure (Baumeister & Heatherton, 1996; Detweiler-Bedell, Friedman, Leventhal, Miller, & Leventhal, 2008). The desire to treat psoriasis symptoms with prescription medicine conflicted with the desire to avoid side effects. Internal conflict was exacerbated by perceived ambiguity regarding treatment success and the belief that individuals had little control over their symptoms (Thorneloe et al., 2013). Participants identified stress as both a cause and a trigger of psoriasis, and they highlighted continuing conflicts between the need to avoid stressor exposure and their need to adhere to psoriasis therapy that is a source of stress. Unresolved emotional pain, a lack of perceived control, and a high level of psoriasis management ambiguity emerged from these issues (Thorneloe et al., 2013).

Overall, these findings suggest that the high rates of psychological difficulties among people living with psoriasis are not simply reducible to the chronicity or severity of the disease.

There seems to be complex and dynamic interactions between thought, emotions and behaviours (Henry et al., 2019; Thorneloe et al., 2017). The cognitive processes that guide some of the behaviours and coping procedures are potentially centred around psoriasis (Henry et al., 2019). This might be due to the attentional biases towards symptoms and negative illness-related thoughts and concerns, which heightens arousal and anxiety (Beattie, Kyle, Espie, & Biello, 2015; Finan, Quartana, & Smith, 2015; Russell, Wearden, Fairclough, Emsley, & Kyle, 2016) and can ultimately impair the engagement and maintenance of required health-related behaviours (Henry et al., 2019). Given the high prevalence of obesity in psoriasis that has been already discussed in Chapter two, the significant role of psoriasis illness perceptions and beliefs in guiding behaviours, and the lack of strong association between depression and body weight in psoriasis, it appears relevant to investigate some of these broader theories driven constructs in relation to living with obesity and psoriasis.

4.8. Common Sense Model of Self-Regulation and obesity

As discussed in Chapter two, current obesity management practices in psoriasis mainly rely on behavioural approaches such as aiming to increase physical activity and promote calorie restricted diets. Thus, overlooking the complex psychosocial challenges of psoriasis, despite the recommended individualised treatment approach to obesity (Hauner et al., 2014).

Through the adoption of the CSM-SR, the context of living with psoriasis can be acknowledged in obesity management strategies, by emphasising on how cognitive and emotional representations can inform coping procedures, and subsequently contribute to improved weight outcomes in psoriasis. The CSM-SR has been key to promoting individualised treatment approaches to overall general one-size-fits all interventions (Breland, Fox, Horowitz, & Leventhal, 2012). For example, improved illness perceptions in terms of

the causes and consequences of diabetes following a CSM-SR-based intervention led to improved blood glucose monitoring and management in diabetes; therefore, this can be applied to general weight management approaches to try and maximise and sustain treatment effects (Clar, Barnard, Cummins, Royle, & Waugh, 2010; Welschen et al., 2005).

Despite the popularity of the CSM-SR in the area of long-term conditions, constructs of the CSM-SR have been seldom evaluated in obesity, with the exception of few cross-sectional (Brogan & Hevey, 2009; Prill, Henning, Schroeder, Steins-Loeber, & Wolstein, 2021) and qualitative studies (Breland et al., 2022; De Brún, McCarthy, McKenzie, & McGloin, 2015). Evidence from these studies suggested that people perceive obesity as a chronic condition that is not necessarily controllable. Illness representations of obesity emphasised the complexity of the causes and consequences of high body weight and its management which varied among people. Some people viewed obesity as a health threat, others were concerned with the negative consequences of obesity on appearance, whereas others did not consider obesity as a concern (Breland et al., 2022). The ability of the CSM-SR to capture these inconsistencies in illness representations provides the opportunity to apply the model to gain a patient-centred understanding of obesity and its associated self-management behaviours.

Important gender differences also emerged from the available studies. Females, but not males, considered obesity as an illness, and the timelines and symptoms of the illness were perceived to fluctuate rather than to be consistently present (Prill et al., 2021). These gender differences might be due to gender-specific dietary behaviours. Women with obesity diet more frequently (Santos, Sniehotta, Marques, Carraça, & Teixeira, 2017; Tronieri, Wurst, Pearl, & Allison, 2017) which ultimately raises the risk of unstable weight due to frequent

changes (Montani, Schutz, & Dulloo, 2015). With no intention to underestimate the likely gender-specific experiences of obesity, it should be noted that most of the people included in this study were female (82%). For this reason, the illness representations of males may not be accurately captured, findings that are also likely applicable to other studies which recruited predominantly females (73%) (Brogan & Hevey, 2009). Together these findings align with the notion of the call for greater consideration on individual factors when applying the CSM-SR (Leventhal, 2019) as well as the need to take gender-specific approach in the context of obesity research (Himmelstein, Puhl, & Quinn, 2019).

4.9. Common Sense Model of Self-Regulation and multimorbidity

Traditionally, the CSM-SR has been used to understand illness representations of how people view single conditions (e.g., either psoriasis or obesity), as indicated in the sections above.

Despite that, there is also research available on trying to understand illness representations in the context of multimorbidity (known as living with two or more chronic conditions such as psoriasis and comorbid obesity) (Valderas, Starfield, Sibbald, Salisbury, & Roland, 2009).

The presence of multimorbidity may raise additional challenges and also influence how people cope with their condition(s). Committing to required health-related behaviours in the context of the other comorbid condition(s) may be challenging (Bayliss, Steiner, Fernald, Crane, & Main, 2003). For example, people living with *psoriasis* may struggle with embarrassment and body image issues, as discussed in Chapter one. Such experiences can interfere with their abilities to commit to required *obesity* management behaviours. The interaction of living with both psoriasis and comorbid obesity may lead to underregulating (i.e., the presence of psoriasis may hamper the regulation and management of obesity or vice versa) (Detweiler-Bedell et al., 2008).

In the context of multimorbidity, illness representations may reflect both illness-specific factors and individual factors, including psychological factors (e.g., self-efficacy) (Warner et al., 2011). Illness representations can be impacted by multimorbidity differently, based on the CSM-SR. The presence of multimorbidity may influence each of the conditions individually. For example, multimorbidity may reduce the perceived controllability of psoriasis as a result of its interaction with obesity or vice versa. From another hand, the presence of multimorbidity itself may impact illness perceptions in relation to the interaction of both conditions – if both conditions are perceived as related or unrelated. Such perceptions are likely to have behavioural consequences (Spoor et al., 2007). This evidence forms the scope of the qualitative and quantitative studies within this thesis which appreciated that illness representations may be impacted by living with psoriasis and comorbid obesity. The qualitative explorations (Chapter seven) and the quantitative investigations (Chapter eight) provide additional insights into the variety of illness perceptions that people living with psoriasis and comorbid obesity hold and how these may affect their self-management behaviours, in particular weight-loss related ones.

4.10. Conclusive remarks of the chapter

The primary focus of this chapter was to review some of the currently unappreciated relevant theoretical approaches that may help guide future research into the underlying unhelpful weight loss management behaviours such as emotional eating. The high affective burden associated with psoriasis and comorbid obesity, and the mostly weak association between depression or anxiety with body weight in psoriasis, supports the need to explore theory-driven underlying mechanisms of affect management and their possible link to weight related behaviours. In particular, the discussion focused on theories of emotional eating (Affect Regulation Theory (Kaplan & Kaplan, 1957) and Escape Theory (Heatherton & Baumeister, 1991) which argued that eating serves as an affect regulator for decreasing negative affect. To integrate the context of psoriasis, the Common-Sense Model of Self-Regulation was also considered as an additional concept underlying the theoretical underpinnings of this thesis. Cognitive factors (e.g., illness perceptions) related to how people view their psoriasis may directly influence coping behaviours (e.g., how people cope with their psoriasis) (Leventhal et al., 2016) and have emerged as important weight loss determinants (Kim et al., 2014). Illness representations might guide coping behaviours of people living with psoriasis, more specifically emotional eating as highlighted by the ART, ultimately challenging successful weight loss outcomes (Spoor et al., 2007).

Our understanding of the application of the emotional eating models and the CSM-SR in the context of body weight and psoriasis is limited due to a paucity of quantitative investigations (cross-sectional and longitudinal) and qualitative explorations. Although cognitive and emotional representations have been studied in the psoriasis context, there is a research vacuum on the role of these components in relation to obesity especially in this patient population. To fill this gap, the investigations presented in this thesis aimed to understand

obesity in psoriasis from a holistic perspective by looking into the broader cognitive, emotional, and behavioural factors in relation to body weight in psoriasis. For such under researched areas, mixed methods approaches may be best suited. The next chapter will provide an overview of the method used in this thesis to meet its objectives.

Chapter 5: Thesis rationale and overview

5.1. Chapter overview

The preceding chapters have demonstrated the need to better understand and manage obesity in psoriasis. As outlined in Chapter two, psoriasis is associated with high physical and psychological burden and obesity as a comorbidity may further exacerbate the negative experiences of living with the skin disease, including clinical outcomes (e.g., sub-optimal treatment response and more severe psoriasis symptoms) and psychological problems (e.g., low self-esteem and negative body image) (Bardazzi et al., 2010; Edson-Heredia et al., 2014; Naldi et al., 2008; Rodríguez-Cerdeira et al., 2019; Snekvik et al., 2019). Chapter two provided evidence for the link between obesity and psoriasis and examined the strengths and limitations of current management programmes for obesity.

The overarching aim of the empirical studies of this thesis is to address the gaps in the current obesity management psoriasis literature by identifying the cognitive, emotional, and behavioural factors that may contribute to obesity in psoriasis and ultimately be used to develop more tailored interventions for this group. A mixed-methods approach was used to address these aims. The rationale for using mixed methods is provided in this chapter, beginning with an overview of the characteristics of quantitative and qualitative research methods and their associated paradigms, followed by a discussion of the benefits and challenges of combining these approaches, and a justification for using mixed methods in the context of this thesis.

5.2. Thesis overview

A summary of the studies available within this thesis with their corresponding reference numbers used in the discussions below is available in the Table 4.

Table 4. *Summary of the studies available within this thesis*

Study identifier (#)	Title	Type of study design	The research question the study aimed to address
Study 1	Psychosocial aspects of obesity in adults with psoriasis: a systematic review	Systematic review	Which psychosocial factors are associated with obesity in psoriasis?
Study 2	The importance of illness severity and multimorbidity in the association between mental health and body weight in psoriasis: cross-sectional and longitudinal analysis	Quantitative cross-sectional and longitudinal	Are depression and anxiety associated with obesity in psoriasis cross-sectionally and over 12 months follow-up when controlling for important demographic and illness-related factors?

Study 3	‘I don’t know which is the chicken and which is the egg’: a qualitative study of weight loss-related cognitions and behaviours among adults with psoriasis and comorbid obesity	Qualitative thematic analysis	What are the beliefs and perceptions related to weight-loss in people living with obesity and psoriasis?
Study 4	Emotional eating and illness perceptions, but not depression and anxiety, are associated with high body weight in psoriasis: a cross-sectional study	Quantitative cross-sectional	What are the cognitive, emotional, and behavioural factors that are associated with body weight in people living with psoriasis?

The systematic review (Study 1) and the quantitative analysis of an existing dataset (Study 2) highlighted a number of important gaps in the research of obesity management in psoriasis. A substantive qualitative study (Study 3) allowed the selection of potential cognitive and behavioural factors that may be important to consider in weight loss in psoriasis. This empirical evidence alongside the theoretical underpinning of this thesis, discussed in Chapter four, helped the selection of measurements for the final cross-section study within this thesis (Study 4). Overall, based on the cognitive, emotional, and behavioural factors identified in Studies 1, 2, 3, and 4, the thesis concluded with an overview of the relevant factors that should be considered as part of obesity management interventions in psoriasis. This is presented in Chapter nine. The operationalisation of these factors is discussed in the subsection below in terms of the measurements used to assess them. An outline of the outcomes in the studies of this thesis is also provided.

5.3. Rationale for using mixed methods

5.3.1. Characteristics of quantitative and qualitative research

A positivist paradigm is frequently adopted within quantitative methodologies. Researchers who operate under this paradigm tend to have an ontological stance of realism, which is defined as a belief in a true, independent, and knowable reality (Krauss, 2005). Realists adopt an epistemological perspective that emphasises on objectivity, contending that careful observation, evaluation, and testing using true and reliable metrics is the best way to identify broad truths about a variety of events (Madill, Jordan, & Shirley, 2000).

Positivism is linked to a deductive approach to research (Bishop, 2015; Johnson & Onwuegbuzie, 2004). The benefits of quantitative methods include their ability to test hypotheses with large samples, their capacity to generalise findings after replication of results

in samples of the right size, their capability to more precisely determine cause and effect relationships, and their capability to produce results that can be argued to be independent of the researcher (Johnson & Onwuegbuzie, 2004). Quantitative research methods are predominantly used in psychology (Whorley & Addis, 2006) and remain dominant in health psychology, which may be due in part to its close ties to medical disciplines (Dures, Rumsey, Morris, & Gleeson, 2011).

Qualitative research, on the other hand, is often associated with a constructivist framework. Qualitative researchers adopt ontological perspective of relativism, which is defined as the belief that individuals and their interactions with their sociocultural surroundings shape many realities (the state of things that exist) (Levers, 2013; Denzin & Lincoln, 2005). According to subjectivism, an epistemological stance held by relativists, knowledge about the world is created (as opposed to discovered) through interpretations of individuals' experiences within their sociocultural context (Levers, 2013; Denzin & Lincoln, 2005). Qualitative data tends to be acquired inductively through interviews and focus groups (Scotland, 2012). The ability to establish an in-depth understanding of a phenomenon, to acquire insight into the contextual elements of complex existences, and to flexibly explore new concepts or themes as they emerge through participant-guided interviews are all strengths of subjectivism as an epistemological position (Johnson & Onwuegbuzie, 2004). Qualitative methods are becoming increasingly popular in health psychology. The acceptability of integrating qualitative and quantitative research methodologies has prompted interest in mixing these approaches (Yardley, Morrison, Bradbury, & Muller, 2015). The approaches can be complementary, drawing on their unique strengths.

Despite the strengths of combining qualitative and quantitative methodologies, mixed-methods research has several challenges. Purists in both paradigms believe that their approach is superior to the other's (Johnson & Onwuegbuzie, 2004). According to positivists, qualitative procedures are highly subjective, ungeneralisable, and lack scientific validity. Conversely, quantitative methods are criticised by constructivists for disregarding contextual factors that inherently influence participant experiences, as well as for restricting participants' responses to the measures chosen by the researcher, limiting their ability to express alternative points of view (Yardley et al., 2015). Such arguments are formulated as 'incompatibility hypotheses' and are based on the idea that qualitative and quantitative methods are inherently incompatible (Karasz & Singelis, 2009).

5.3.2. A practical method to mixing qualitative and quantitative methodologies

In contrast to the 'incompatibility hypotheses' that focus on the limitations of combining qualitative with quantitative methods, there is a third paradigm of pragmatism that tries to move past the qualitative versus quantitative argument, acknowledging the value of both techniques when utilised in mixed methods designs (Johnson & Onwuegbuzie, 2004). Purist constructivists and positivists have historically been harsh critics of each other's methodologies. Critics, on the other hand, have frequently focused on the flaws of the other technique, paying little attention to the flaws in their own convention. Pragmatists do not argue that critiques of either technique are unsupported; rather, they argue that these objections may be exaggerated, and that the merits of one method may be neglected by the other (Kelle, 2006). As a result, they accept a pluralist ontological viewpoint, which implies that knowledge can be produced as well as anchored in context (Bishop, 2015). Pragmatists reject objective-subjective dualism in favour of inter-subjectivity (research is neither purely objective nor subjective in nature) as an epistemic perspective. Inductive-deductive dualism

is also opposed by pragmatists, who prefer to approach information acquisition through abduction, flowing fluidly between induction and deduction (Morgan, 2007). Therefore, pragmatists argue that using mixed-methods allows one to take advantage of both the strengths of qualitative and quantitative investigation while also addressing their limitations, as opposed to viewing one paradigm as superior to the other (Johnson & Onwuegbuzie, 2004).

In a variety of ways, qualitative and quantitative methodologies can supplement one other. Qualitative research provides rich, meaningful data from different sociocultural perspectives. These data can inform quantitative research and ensure that these perspectives are captured in the generation of hypotheses, the operationalization of theoretical constructs, and the development of measurement instruments for use in quantitative research (Yardley, & Bishop, 2008).

Collecting both qualitative and quantitative data within a research study also allows for more in-depth exploration of participants' personal experiences and perspectives, rather than limiting data to the quantitative measures specified by the researcher. Although the gathering and interpretation of real-world contexts gives qualitative research strong external validity, it comes at the expense of the precision, control, and reliability provided by quantitative research methods (Pope & Mays, 1995; Yardley, & Bishop, 2008).

Mixed-methods research has many uses in psychology, but the iterative use of qualitative and quantitative methods throughout the development and evaluation of interventions may be particularly valuable. Qualitative data gathered through interviews, focus groups, or early

surveys can inform new areas of investigation. For example, the use of qualitative research can help to identify constructs that can be measured in quantitative studies. Subsequently, quantitative methods can be used to assess the intervention's impact, and qualitative research can then be used to gain a better understanding of the intervention's process and identify potential impediments to change (Campbell, Taylor, & McGlade, 2016).

Overall, combining qualitative and quantitative research may be motivated by the desire to produce knowledge that is applicable and has a significant impact in a variety of contexts rather than knowledge that is completely generalisable or context-bound (Bishop, 2015; Morgan, 2007; Yardley, & Bishop, 2008). Because the advantages and disadvantages of each research approach vary depending on the topic of interest, methods should always be chosen based on their suitability for solving a specific research question (Yardley, & Bishop, 2008).

5.3.3. Implementing mixing methods successfully

According to pragmatists, utilising mixed-methods approach can frequently provide a more comprehensive answer to a research question than using one method alone. However, mixed-methods research should not be utilised indiscriminately, but to be used to answer appropriate research questions. One of the most prominent criticisms of mixed-methods research is that researchers rarely present an appropriate argument for mixing approaches and do not incorporate qualitative and quantitative methods or findings effectively (Kelle, 2006). To fully utilise the potential of both methodologies, one must first comprehend the goals and assumptions of both paradigms to avoid conflicts between these constructs. Traditionally speaking, qualitative methods are less frequently used than quantitative methods and may not be employed correctly. For example, qualitative methods are widely used as a supplement to

quantitative methods, as a prelude to quantitative research, or to highlight or expand on quantitative findings. When findings conflict, researchers with implicit positivist attitudes are more prone to dismiss qualitative findings rather than accepting them as a separate type of evidence that reflects a different and important sort of reality (Yardley, & Bishop, 2008).

To prevent the issues stated above, one must be explicit about how and why mixed methods are being used. To properly integrate methodologies, the focus placed on each method in a program of study should be carefully considered to establish whether there is a dominant approach or whether the worth of each approach is weighted equally. Although methodological balance if not a requirement per se, studying dominance may provide a valuable point of reflection since there are various processes (e.g., culture of the research team, editorial procedures) that may lead to unanticipated emphasis of one method or the other (Creamer, 2017). Several steps were undertaken to ensure appropriate use of quantitative and qualitative approaches in this thesis (Walker & Baxter, 2019). Evaluations of the reasoning behind the use of each method (i.e., the primary aim) (Creswell, Plano Clark, Gutmann, & Hanson, 2003), the amount of details given about each method (through data collection, analysis), and the quality and rigour of each strand (Baxter & Eyles, 1997) were conducted to establish the appropriate research dominance, in the context of this thesis. Using examples of previous studies (Baxter & Eyles, 1997; Bryman, 2006), an independent criteria for analysing the apparent rigour was used of quantitative (e.g., validity, reliability, generalisability) and qualitative (e.g., credibility, transferability, dependability) separately (Walker & Baxter, 2019).

Research method dominance was also linked to method sequence. First, explanatory sequential method (i.e., quantitative first, Study 2) was used, ensuring that the use of a qualitative method, after the quantitative, was rationalised as a method used to expand and

delve deeper into the research question. The qualitative methods used in this thesis allowed for comprehensive understanding (Janhunen, Hujala, & Pätäri, 2014), triangulation (Lombard & Ferreira, 2014), and to explore actual viewpoints (Frantál & Kunc, 2011). Semi-structured interviews (Study 3) were used to further investigate the findings that arose from the quantitative study (Study 2). This decision was also supported by the fact that conducting interviews after quantitative methods may uncover thought-provoking factors that may not necessarily emerge from quantitative studies (Varho & Tapio, 2005). Second, exploratory sequential method was implemented (qualitative first, then quantitative). Findings from the interview study were used to inform the quantitative investigations to investigate which of the emerging qualitative factors may determine weight-related outcomes (Study 4) (Yiridoe, 2014).

Overall, this thesis acknowledged the challenges of mixed methods, discussed above, in order to establish whether mixed-methods should be used within one study, or if the combined findings of separate mono-method studies are more useful (Dures et al., 2011; Johnson & Onwuegbuzie, 2004; Yardley, & Bishop, 2008). Rationales for the use of the chosen research method are discussed within each paper (Study 2, 3, and 4), outlining their applicability to the research questions (Walker & Baxter, 2019).

5.4. Methods within this thesis

There is insufficient existing evidence from either qualitative or quantitative approach to inform a holistic weight loss intervention that integrates a psychological approach into the general, behavioural change focused, weight loss management guidance for obesity in the context of psoriasis. As shown by the systematic review, there is only a small number of cross-sectional quantitative studies (N= 16) and no qualitative studies that explored the

psychosocial perspective of obesity in psoriasis. As previously acknowledged, the cognitive, emotional, and behavioural aspects of obesity in psoriasis have also received limited research attention.

Given the comprehensiveness of mixed methods approaches which can better inform intervention design (as explained earlier), mixed methods approach was considered as an appropriate methodology to adopt here. In the empirical investigations of this thesis, a pluralist methodological approach and relevant research techniques were used, based on the research goals. Qualitative and quantitative methods were considered as complimentary (Yardley, & Bishop, 2008). Each study was separately analysed and reported with the purpose to build up on the knowledge and research gaps addressed by the preceding one, and to inform and refine the research goals of the subsequent. The completion of the qualitative and quantitative research analysis informed the last cross-sectional study of this thesis that outlined the relation of cognitive, emotional, and behavioural factors to weight-loss related outcomes in psoriasis.

A Psoriasis Public and Patient Involvement (PPI) group provided feedback on different aspects of recruitment materials across the studies. The consideration of inviting PPI group to the studies within this thesis was made to improve the quality and relevance of the conducted research. PPI representatives can bring a different perspective to a study, highlight areas that people living with psoriasis consider as important, and ensure research questions and subsequent findings are relevant to patients and their caregivers (Biggane, Olsen, & Williamson, 2019).

For Study 3, PPI group provided feedback on the study information sheet and the interview schedule. The feedback on the study information sheet focused on clarifying the link between obesity and psoriasis in a lay language. The PPI also suggested inclusion of probes within the interview schedule such as what qualifies for moderate physical activity. For study 4, PPI group provided feedback on the study information sheet and on the instructions for completing the questionnaires. Feedback mainly suggested clarifying used terms such as ‘emotional eating’ and clarifying the link between obesity and psoriasis in a lay language (similarly to the feedback provided for study 3). PPI’s group feedback for both studies were implemented to improve relevance of the used materials.

5.5. Weight-related outcome data

The weight-related outcomes within this thesis were body mass index (BMI) and waist circumference. Measurements of body weight and height only (allowing the calculation of body mass index, BMI) (Study 3) or in combination with waist circumference data (Study 2 and Study 4) were collected in either self-reported format (Study 3 and Study 4) or was available from routinely collected data as part of standard care (Study 2). As indicated by the systematic review (Study 1), obesity is most frequently considered in the context of high BMI, an index for relating weight to height, as means of determining whether a person's weight is healthy (NHS, 2019). However, BMI does not differentiate between body fat mass and muscle mass (Luz, Barbosa, & d'Orsi, 2016). Hence, it is not a reliable indicator of actual body fat mass (Luz et al., 2016). This is crucial because a higher percentage of visceral fat is associated with poor physical and mental health outcomes (Speed et al., 2019). Waist circumference was incorporated as a more accurate indicator of body fat within this thesis, alongside BMI, due to the assumption that more precise assumptions can be drawn in relation to associations of interest within this thesis (Speed et al., 2019).

BMI was calculated as weight in kg divided by height in m². BMI categories were defined as healthy weight (BMI between 18.5 and 24.9 kg/m²), overweight (BMI between 25.0 and 29.9 kg/m²), obese (BMI between 30.0 and 40.0 kg/m²), and morbidly obese (BMI ≥ 40.0 kg/m²) (NHS, 2019). The threshold for healthy waist circumference was defined as < 94 cm and 80 cm for men and women, respectively (NHS, 2021). Abdominal obesity was considered as ‘present’ if the threshold was reached or exceeded – allowing the use of dichotomised data on waist circumference (presence/absence of abdominal obesity) in Study 4 due to the scarcity of self-reported concrete measurements of waist circumference (in cm or inches). Such dichotomisation is likely to have obscured the association between mental health with weight-related outcomes due to reduced power (Fedorov, Mannino, & Zhang, 2009). Differently, continuous measurements of waist circumference were available within the routinely collected data (Study 2), allowing more robust explorations of the association between predictors and outcomes. The use of routinely collected weight-related data might have also prevented overestimation or underestimation of the reported data (likely with self-reported data). However, a typical characteristic of the use of routine data was also observed the study in terms of the substantial amount of missing weight-related data which reduced the analytical samples of patients.

5.6. Questionnaire methods

This sub-section provides a detailed overview of the questionnaires used in the studies of this thesis used to operationalise the variables of interest across the studies. Summaries of the used questionnaires are also available in the respective papers.

5.6.1. Patient Health Questionnaire for Depression

Patient Health Questionnaire (PHQ) is a multi-choice self-report inventory that is used as a screening and diagnostic tool for depression (Spitzer, Williams, & Kroenke, 2014). It has been used in patient populations with long-term conditions, including psoriasis (Lamb et al., 2017; Pavlova et al., 2021; Kroenke, Spitzer, & Williams, 2001; Spitzer, Kroenke, Williams, & Löwe, 2006; Dbouk, Arguedas, & Sheikh, 2008; Monahan et al., 2009; Williams et al., 2005). PHQ assesses the experiences of depression symptoms over the past two weeks on a four-point Likert scale from 0 (Not at all) to 3 (Nearly every day). Total scores are computed on the basis of items included in the questionnaire, with higher scores indicating higher levels of depressive symptoms (Kroenke et al., 2001; Spitzer et al., 2006). There are different item versions available, as indicated by the name of the questionnaire i.e., PHQ-X, where X represents the number of items included in the questionnaire (e.g., PHQ-2 is a two-items questionnaire). Excellent psychometric quality of the PHQ has been previously observed with internal reliability of 0.82 and above (Kroenke et al., 2001; Spitzer et al., 2006).

For the study on *‘The importance of illness severity and multimorbidity in the association between mental health and body weight in psoriasis- cross-sectional and longitudinal analysis’* (Study 2, presented in Chapter six), PHQ-2 and PHQ-9 were used. All participants completed PHQ-2 (Kroenke, Spitzer, & Williams, 2003) consisting of the first two items of the PHQ-9. Participants answering positively (‘More than half the days’ or ‘Nearly every day’) to at least one item went on to complete the remaining items of PHQ-9. Probable major depressive disorder (MDD; ‘depression’ in the manuscript) was defined in accordance with the DSM-V criteria (Edition, 2013) as (i) responding positively to one of the first two items (‘Little interest or pleasure in doing things’, ‘Feeling down, depressed, or hopeless’); and (ii) responding positively to a minimum of five other depression symptoms. If one of the reported

symptoms was suicidality (“Thoughts that you would be better off dead, or of hurting yourself”), an answer of ‘Several days or more’ often would indicate a positive response. Total scores range of PHQ-9 were computed with a range of 0 to 27, with higher scores indicating higher levels of depressive symptoms (Kroenke et al., 2001; Spitzer et al., 2006).

For the study on ‘*Cognitions, emotions, and behaviours concerning body weight and psoriasis*’ (Study 4, presented in Chapter eight), PHQ-8 was used. Total scores are computed with a range from 0 to 24, with higher scores indicating higher levels of depressive symptoms (Kroenke et al., 2001; Spitzer et al., 2006). For this particular study, PHQ-8 was selected over the PHQ-9 because previous studies suggest comparable psychometric performance while it excludes the item capturing suicidal ideation (‘thoughts that you would be better off dead or of hurting yourself in some way’) (Shin, Lee, Han, Yoon, & Han, 2019). Given the online nature of the study and limited opportunity for support provision and follow-up, this was deemed most appropriate here.

The following cut-off scores have been defined for both PHQ-8 and PHQ-9: 0-3 indicated ‘normal’ or ‘minimal’ depression; 4-8 indicated ‘mild’ depression; 9-13 indicated ‘moderate’ depression; 14-18 indicated ‘moderate-severe’ depression; and 19+ indicate ‘severe’ depression.

5.6.2. Generalised Anxiety Disorder Scale for Anxiety

Generalised Anxiety Disorder (GAD) Scale is a self-reported questionnaire for screening and severity measuring of generalised anxiety disorder (Spitzer et al., 2006). It has been used in patient populations with long-term conditions, including psoriasis (Lamb et al., 2017; Pavlova et al., 2021; Kroenke et al., 2001; Spitzer et al., 2006; Dbouk et al., 2008; Monahan

et al., 2009; Williams et al., 2005). GAD assesses the experiences of anxiety symptoms over the past two weeks on a four-point Likert scale from 0 (Not at all) to 3 (Nearly every day). Total scores are computed on the basis of items included in the questionnaire, with higher scores indicating higher levels of anxiety symptoms (Kroenke et al., 2001; Spitzer et al., 2006). Similarly to PHQ, there are different item versions available, as indicated by the name of the questionnaire i.e., GAD-*X*, where *X* represents the number of items included in the questionnaire (e.g., GAD-2 is a two-items questionnaire). Excellent psychometric quality of the GAD-7 has been previously observed with internal reliability of 0.83 and above (Kroenke et al., 2001; Spitzer et al., 2006).

For the study on *‘The importance of illness severity and multimorbidity in the association between mental health and body weight in psoriasis- cross-sectional and longitudinal analysis’* (Study 2, presented in Chapter six), GAD-2 and GAD-7 were used. All participants completed GAD-2 (Spitzer et al., 2006) consisting of the first two items of the GAD-7. Participants answering positively (‘More than half the days’ or ‘Nearly every day’) to at least one item went on to complete the remaining items of the GAD-7. Probable generalised anxiety disorder (GAD; ‘anxiety’ in the manuscript) was defined as (i) responding positively to one of the first two items (“Feeling nervous, anxious, or on edge”, or “Not being able to stop or control worrying”); and (ii) a total score of ≥ 10 (out of a total of 21).

The following cut-off scores for GAD-7 have been defined: 0-5 indicated ‘mild’ levels of anxiety; 10-14 indicated ‘moderate’ levels of anxiety; and 15+ indicated ‘severe’ levels of anxiety (Kroenke et al., 2001; Spitzer et al., 2006).

The discussion below focused on the remaining measures, all of which are relevant to the final study of this thesis: *‘Emotional eating and illness perceptions, but not depression and anxiety, are associated with high body weight in psoriasis: cross-sectional study’* (Study 4, presented in Chapter eight).

5.6.3. The Dutch Eating Behaviour Questionnaire for Emotional Eating

The Dutch Eating Behaviour Questionnaire (DEBQ) is a 33-item scale that aims to assess three distinct eating behaviours in adults: (1) emotional eating (13 items), (2) external eating (10 items), and (3) restrained eating (10 items) (Van Strien, Frijters, Bergers, & Defares, 1986). The scope of this paper required the use of emotional eating sub-scale only. Items are scored on a five-point Likert scale from 1 (Never) to 5 (Very often). Total scores are computed with a range from 13 to 65, with higher scores indicating higher levels of emotional eating. DEBQ has been used successfully in weight management research with a psychological focus with different patients populations such as diabetes (Hays, Finch, Saha, Marrero, & Ackermann, 2014). Excellent psychometric quality of the DEBQ has been previously observed with internal reliability of 0.95 in people with chronic conditions (Hays et al., 2014), in this sample Cronbach’s $\alpha = 0.96$.

Both laboratory and naturalistic studies highlighted the consumption of sweet, high-fat foods in response to certain types of negative emotions. However, laboratory methodologies may not accurately reflect typical emotional eating environment, thus suggesting a lack of correlation between self-reported emotional eating and actual food consumption (Domoff, Meers, Koball, & Musher-Eizenman, 2014). The DEBQ has been used successfully in weight management research that acknowledged the psychological factors in different patient populations such as diabetes and cardiovascular problems (Eliashevich, Dubolazova, & Drapkina, 2017; Hays et al., 2014).

5.6.4. Illness Perceptions Questionnaire-Revised for Psoriasis Illness Perceptions

To measure representations of illness and symptom, a number of self-report measures have been created (Hagger & Orbell, 2003) based on Leventhal's Common Sense Model (CSM) (Leventhal et al., 1980). One such instrument is the Illness Perception Questionnaire (IPQ) (Weinman et al., 1996). The IPQ has been systematically developed and tested in several illness groups. However, this original instrument was found to have psychometric issues, including low internal consistency of the cure/control and timeline subscales. Furthermore, the IPQ did not measure two key parts of the common sense which are emotional representations and illness coherence (Moss-Morris et al., 2002). To address these problems, a revised version of the IPQ (IPQ-Revised; IPQ-R) was created utilising factor analysis and a large sample of 711 patients from eight illness populations (Moss-Morris et al., 2002). The IPQ-R includes 3 scales – symptoms perceptions, views about the illness, and causes of the illness. For the purpose of this thesis, views about the illness scale is used with its relevant subscales, including (i) timeline (perceived chronicity and cyclicity of illness); (ii) consequences (perceived impact of illness); (iii) control (perceived personal and treatment control over illness); (iv) illness coherence (perceived understanding about illness); and (v) emotional representations (emotional response to illness). Items are scored on five-point Likert scale from 0 (Strongly disagree) to 4 (Strongly agree). A few items on personal and treatment control, and illness coherence are scored backwards. Total scores are computed with a range from 0 to 30. High scores on the identity, timeline, consequences, and cyclical dimensions represent strongly held beliefs about the number of symptoms attributed to the illness, the chronicity of the condition, the negative consequences of the illness, and the cyclical nature of the condition. High scores on the personal control, treatment control and coherence dimensions, represent positive beliefs about the controllability of the illness and a

personal understanding of the condition. The IPQ-R is extensively used and has high psychometric quality, with Cronbach's alpha ranging from 0.79 to 0.89 across all subscales (Moss-Morris et al., 2002). The subscales in this sample demonstrated acceptable internal consistency, ranging from $\alpha = 0.72$ to $\alpha = 0.89$, except for the consequence items subscale that demonstrated poor internal consistency of $\alpha = 0.51$.

5.6.5. The Psoriasis and Body Weight Representations Questionnaire for Psoriasis and Body Weight Illness Perceptions

The Diabetes and Depression Representation and Management Questionnaire (DDRMQ) is a self-reported questionnaire, measuring understanding and management of diabetes, and beliefs about diabetes medication in people with diabetes and depression (Mc Sharry, Bishop, Moss-Morris, Holt, & Kendrick, 2015). The DDRMQ consists of 35 items in ten sub-scales relating to representations of the relationship between diabetes and depression, reported self-management and general and condition-specific medication beliefs (Mc Sharry et al., 2015). For the purposes of this thesis, the DDRMQ was adapted to capture cognitive representations of psoriasis and body weight by changing the terminology in the 'diabetes' items with 'psoriasis' and in the 'depression' items with 'body weight'. The following scales and sub-scales were adapted and used:

1. *"Relationship between psoriasis and body weight"* with subscales:
 - a. separate representations on body weight and psoriasis (e.g., my psoriasis is a separate thing from my body weight, adapted from my diabetes is a separate thing from my depression);
 - b. negative linked representations of body weight and psoriasis (e.g., having to manage psoriasis adds to my body weight, adapted from having to manage diabetes adds to my depression);

- c. incoherent understanding of psoriasis and body weight (e.g., the interaction between my psoriasis and weight does not make sense to me, adapted from the interaction between my diabetes and depression not make sense to me).
2. *“Self-management of psoriasis and body weight”* with sub-scales:
- a. separate management of psoriasis and body weight (e.g., I do different things to manage psoriasis and body weight, adapted from I do different things to manage diabetes and depression);
 - b. linked management of psoriasis and body weight (e.g., I do things that help both psoriasis and body weight at the same time, adapted from I do things that help both diabetes and depression at the same time);
 - c. linked management struggle (e.g., when my body weight is high psoriasis is a struggle, adapted from when I am depressed managing diabetes is a struggle);
3. *“What worries you most/affects your life the most”* with available response options as follow: psoriasis, high body weight, having both psoriasis and high body weight, medical conditions other than psoriasis and high body weight;

Items are scored on five-point Likert scale from 1 (Strongly disagree) to 5 (Strongly agree).

Total scores for the subscales are computed with a range from 1 to 20. High scores on separate representations on psoriasis and body weight, negative linked representations of body weight and psoriasis, incoherent understanding of psoriasis and body weight, separate management of psoriasis and body weight, and linked management struggle of both conditions represent strongly held negative beliefs of the relationship between psoriasis and body weight and self-management of the conditions. High scores on linked management of psoriasis and body weight represent a personal understanding on the importance of managing psoriasis and body weight together. The scales have high psychometric quality, with

Cronbach's alpha ranging from 0.70 to 0.86 (Mc Sharry et al., 2015). In this sample, the adapted scales had good internal consistency ($\alpha = 0.72$ to 0.86).

5.7. Sociodemographic, lifestyle, and psoriasis disease-related data

Across the empirical studies in this thesis, a range of sociodemographic, lifestyle and psoriasis disease-related data were collected. Self-reported sociodemographic, lifestyle and disease-related were collected as part of two of the studies (Study 3 and Study 4, presented in Chapters seven and eight, respectively). Clinician reported sociodemographic and disease-related data from patients' health records was available and used as part of Study 2. Table 5 summarises the data collected.

Table 5. *Sociodemographic characteristics in the studies of this thesis*

Characteristic	Options available	Collected in
Sociodemographic characteristic		
Gender	Female, male	Study 2, 3, and 4
Age		Study 2, 3, and 4
Ethnicity	White Mixed/Multiple ethics group Asian/Asian British Black/African/Caribbean Other ethnic group (free text available)	Study 2, 3, and 4
Marital status	Married or civil partnership Widowed Divorced/Separated Single parent Single or never married I prefer not to say	Study 3, and 4
Employment status	Full-time Part-time Contract/ Temporary Furloughed Unemployed Unable to work Homemaker Retired	Study 4

	Other_____ (Answer Space) I prefer not to say	
Higher education	Primary Some secondary GCSE or equivalent A Level or equivalent Diploma Degree or equivalent Higher degree Prefer not to say	Study 4
Lifestyle characteristics		
Smoking status	Smoker Ex-smoker Non-smoker I prefer not to say	Study 4
Alcohol status	Everyday 2-3 times a week 2-3 times a week Once a week Rarely Never I prefer not to say	Study 4
Previous weight loss attempts	Yes No	Study 2 and Study 4
Psoriasis disease-related characteristics		
Years living with psoriasis		Study 2, 3, and 4
Treatment for psoriasis		Study 2, 3, and 4
Total number of comorbid medical conditions		Study 2 and Study 4
Psoriasis severity (PASI scores)		Study 2

The real-world clinical data used in Study 2 (*‘The importance of illness severity and multimorbidity in the association between mental health and body weight in psoriasis- cross-sectional and longitudinal analysis’*, Chapter six) might have provided an opportunity to reflect the actual clinical aspects of the collected data that may have been previously overlooked (Kim et al., 2018). However, there were substantial amount of missing data (a typical characteristic

of routine data) which reduced the analytical samples of patients. Some important sociodemographic characteristics such as employment and marital status, and lifestyle characteristics such as smoking status and alcohol consumption were also not available as part of the patients' health records. An advantage of using routinely collected data was the availability of objectively assessed psoriasis severity (PASI) – data that were not available in the studies using self-reported measures (Study 3 and 4).

5.8. Conclusive remarks of the chapter

This chapter provided a description of the general methodologies relevant to the empirical studies presented in this thesis, including the rationale for the study designs used; and the measurements of key variables. The next chapter includes a research study (Study 2) that built up on the evidence and suggested limitations of the existing studies that investigate the association between psychosocial factors and body weight in psoriasis, identified in the systematic review (Study 1). The study drew on routinely collected data from a specialist NHS psoriasis clinic to gain a better understanding of the role of depression and anxiety in relation to weight-related outcomes in psoriasis. It adds to the small number of studies in this area by examining the association between mental health and body weight, using waist circumference as a valid marker of abdominal and visceral fat (Luz, Barbosa, & d'Orsi, 2016; Speed et al., 2019), in addition to more commonly used BMI. The study improves on prior cross-sectional research by adjusting the analysis for several important demographic and illness-related factors, which could confound links between mental health and weight-related outcomes. In addition, this is the first study to examine these relationships over time.

Chapter 6: The importance of illness severity and multimorbidity in the association between mental health and body weight in psoriasis- cross-sectional and longitudinal analysis

6.1. Chapter overview

The previous chapters highlighted that the knowledge of the psychosocial factors that may play a role in obesity in psoriasis is limited with several methodological flaws. In particular, most studies that looked into obesity in psoriasis with the acknowledgement of the psychosocial factors (1) were cross-sectional, (2) did not consider important confounding variables, known from the general obesity literature to influence weight-related outcomes, and (3) did not consider the limitations of using BMI only (discussed in Chapter two) as a body weight related outcome. Altogether, the presence of weak or null association between depression or anxiety with body weight, as indicated by the systematic review, was attributed to these methodological limitations.

This chapter presents a study that aimed to address these methodological limitations to further contribute to the evidence of the association between depression and anxiety with body weight. Longitudinal analyses were conducted, in addition to the cross-sectional ones, which aimed to address the limitations of previous studies and to investigate the association between depression and anxiety with body weight cross-sectionally and over time. The studies included in the systematic review failed to control for important demographic (e.g., age, gender, and ethnicity) and illness-related factors (e.g., psoriasis severity, number of comorbidities, and psoriasis treatment) which are known from the general literature to influence body weight as well as psychosocial outcomes, including anxiety and depression. The current study aimed to address this gap and adjusted the presented analysis for these

important confounders. Finally, this study included waist circumference as a more precise measure of body fat, in addition to BMI, that is widely used across general obesity literature. This allowed the investigation of the association between depression and anxiety with two body weight related outcomes, waist circumference and BMI.

Overall, the findings from this study informed the next phase of this research programme and contributed to the general conclusions of this thesis.

This chapter is published in the following article:

N. T. Pavlova, R. Moss-Morris, C. Smith, E. Carr, L. Rayner, F. Picariello (2022). The importance of illness severity and multimorbidity in the association between mental health and body weight in psoriasis: cross-sectional and longitudinal analysis. *Skin Health and Disease*, e117. <https://onlinelibrary.wiley.com/doi/full/10.1002/ski2.117>

Note: Relevant supplementary materials from this study are presented in Appendix B of this thesis.

6.2. Published article

The importance of illness severity and multimorbidity in the association between mental health and body weight in psoriasis: cross-sectional and longitudinal analysis

N. T. Pavlova, MSc¹, R. Moss-Morris, PhD¹, C. Smith, MD^{1,2}, E. Carr, PhD³, L. Rayner, PhD⁴, F. Picariello, PhD^{1*}

¹ Health Psychology Section, Psychology Department, Institute of Psychiatry Psychology and Neuroscience, King's College London, London, United Kingdom

² Guy's and St Thomas' NHS Foundation Trust, St John's Institute of Dermatology, London, United Kingdom

³ Department of Biostatistics and Health Informatics, King's College London, Institute of Psychiatry Psychology and Neuroscience, London, United Kingdom

⁴ Department of Psychological Medicine, Institute of Psychiatry Psychology and Neuroscience, King's College London, London, United Kingdom

Short title: Mental health and body weight in psoriasis

*Corresponding author: Federica Picariello, King's College London, Health Psychology Section, Psychology Department, Institute of Psychiatry Psychology and Neuroscience, Guy's and St Thomas Street, SE1 9RT, London, United Kingdom, +44(0)2071889324, federica.picariello@kcl.ac.uk

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Number of Tables: 5

Number of Figures: 0

Word count: 4206

Key words: obesity management, psoriasis, psychological aspects, risk factors

What is already known?

High body weight, common in psoriasis, is associated with depression and anxiety. Depression and anxiety affect disproportionately women with psoriasis compared to men. Multimorbidity and greater psoriasis severity may increase the psychological burden on patients' lives. Despite that, current research is mostly cross-sectional and underestimates the role of demographic and illness-related factors in the association between depression and anxiety with body weight in psoriasis.

What does this study add?

We found no evidence of associations between depression and anxiety with body weight after adjusting for demographic and illness-related factors. Further research needs to investigate the relationship between depression and anxiety with body weight in a more robust study design and explore the underlying cognitive and behavioural components that may help to explain the high incidence of obesity in psoriasis.

Summary

Background: High body weight is common in psoriasis and is associated with depression and anxiety. Past studies are mostly cross-sectional and may underestimate the role of demographic and illness-related factors in the association between mental health and body weight in psoriasis.

Objectives: This study explored the association between depression and anxiety with waist circumference and body mass index (BMI) cross-sectionally and at 12 months follow-up, adjusting for demographic and illness-related factors in people with psoriasis.

Method: Routine psoriasis care data were combined with data on depression and anxiety from a large specialist psoriasis centre. The analytical samples consisted of patients with complete data on either waist circumference ($N= 326$ at time one; $N=191$ at follow-up) or BMI ($N= 399$ at time one; $N=233$ at follow-up) and corresponding mental health, demographic, and illness-related information. Associations between weight-related outcomes and mental health variables were assessed at time one and at 12 months follow-up, after adjusting for demographic and illness-related factors.

Results: We found no evidence of associations between mental health and waist circumference or BMI, after adjusting for age, gender, and illness-related factors. Higher age, male gender, and illness-related factors, specifically multimorbidity and psoriasis severity, were positively associated with waist circumference and BMI at both time points.

Conclusion: This study revealed the important role of factors related to illness severity in body weight in psoriasis. The contribution of depression and anxiety to weight was not observed here likely due to the sample and methodology used. Future work should explore other psychosocial factors such as weight-related attitudes and emotional eating in the context

of weight in psoriasis, to help inform the development of successful weight-management treatments.

Introduction

Psoriasis is a chronic debilitating inflammatory systemic condition that affects 2-9% of the world's population (Parisi et al., 2013). One third of people living with psoriasis have comorbid obesity (Mahil et al., 2019), defined as a body mass index (BMI) of ≥ 30 kg/m² (Iskandar et al., 2015). Psoriasis and obesity frequently co-occur with depression and anxiety in a bi-directional fashion, where obesity may drive mental health issues and vice versa (Innamorati et al., 2016; G. Kim et al., 2014; Luppino et al., 2010; Pavlova et al., 2021; Payne et al., 2018). This co-occurrence may be due to the physical and emotional toll that psoriasis and comorbid obesity have on patients' lives (Griffiths et al., 2018; Kouris et al., 2015). Pain, discomfort, difficulty performing daily tasks, and low self-esteem are common symptoms of both psoriasis and obesity (Griffiths et al., 2018; Martínez-Ortega et al., 2019).

Obesity is frequently considered in the context of high BMI, an index for relating weight to height, as means of determining whether a person's weight is healthy (National Health Service (NHS), 2019). To date, it is the main indicator of healthy weight considered by studies that investigated the relationship between obesity and mental health in psoriasis (Pavlova et al., 2021). However, BMI does not differentiate between body fat mass and muscle mass (Luz et al., 2016). Hence, it is not a reliable indicator of actual body fat mass (NHS, 2012). This is crucial because a higher percentage of visceral fat is associated with poor physical and mental health outcomes (Speed et al., 2019). Incorporating a more accurate indicator of body fat such as waist circumference, alongside BMI, may allow for more precise monitoring of the association between obesity and comorbid medical and mental

health conditions, including anxiety and depression (Luppino et al., 2010; Pavlova et al., 2021).

Common psoriasis- and obesity-associated comorbidities such as cardiometabolic, kidney, and gastrointestinal diseases are also overlooked in the association between mental health and obesity in psoriasis (Da Costa et al., 2012; Takeshita et al., 2017). These co-morbid conditions may increase the psychological burden on patients' lives (Griffiths et al., 2018). They ought to be considered when determining the association between mental health and obesity in psoriasis. Important nuances related to demographic factors should also be factored in. Depression and anxiety affect disproportionately women with psoriasis compared to men (Golpour et al., 2012). Higher BMI has been linked to depression in females (24.5%, 95% CI=17.2, 33.5), but not in males (11.6%, CI=6.5, 19.7) (Gray et al., 2009; Helmick, Lee-Han, Hirsch, Baird, & Bartlett, 2014; Herva et al., 2006). Age is another important demographic factor that should be considered. As age increases, the association between waist circumference and BMI with depression becomes stronger in the general population (Liao et al., 2020). It is yet to be determined whether there is a link between body weight and mental health in psoriasis and if it is gender- or age-dependent.

To recognise the complex relationship between obesity and mental health in psoriasis, we need to look beyond general weight loss models that focus on dietary habits and physical activity (Pavlova et al., 2021). Tailored illness-specific interventions that recognise the role of demographic, illness-related and mental health factors have been linked to better weight outcomes in other patient populations (Gray et al., 2009; P. J. Morgan et al., 2013).

Depression and anxiety can be significant barriers to engagement with and adherence to weight-loss recommendations, and they can also prevent long-term maintenance of weight loss (Mazzeschi et al., 2012; Somerset, Graham, & Markwell, 2011). Psoriasis management guidelines recommend a holistic approach in which patients' treatment goals include both

weight management and improved mental health (National Institute of Clinical Excellence (NICE), 2012). As a result, it is critical to build a better understanding of the role of depression and anxiety in psoriasis body weight, taking into consideration nuances related to demographic factors and illness severity. This would allow for a more tailored and effective approach to weight reduction that addresses the multifaceted needs of people living with psoriasis, ultimately resulting in better patient outcomes (Pavlova et al., 2021).

This study used data collected as part of routine specialist care to gain a more robust understanding of the role of depression and anxiety in psoriasis patients' weight-related outcomes (including waist circumference and BMI), considering the limitations of earlier studies. First, the relationship between illness-related factors and body weight outcomes in psoriasis were assessed to determine if they may be potential confounds in the relationship between depression or anxiety and weight-related outcomes. Secondly, we assessed the relationship between mental health and weight outcomes when adjusting for both demographic and illness related factors cross sectionally. We also explored the longitudinal relationship between mental health at time one with body weight outcomes measured at 12 months follow-up. The following hypotheses were formulated.

1. Multimorbidity and more severe psoriasis at time one will be positively associated with waist circumference and BMI (i) at time one and (ii) at 12 months follow-up; after adjusting for demographic variables (age, gender, and ethnicity).
2. Depression and anxiety at time one will be positively associated with waist circumference and BMI (i) at time one and (ii) at 12 months follow-up; after adjusting for demographic and illness-related variables (psoriasis severity, comorbidities, and psoriasis treatment).

3. Gender will moderate the relationship between depression and anxiety at time one with waist circumference and BMI (i) at time one and (ii) at 12 months follow-up; where the relationship between depression and anxiety with waist circumference and BMI at both time one and 12 months follow-up will be greater for women than men.

Methods

Patients

Patients were recruited between 2014 and 2020 during routine dermatology outpatient visits at a large specialist psoriasis centre serving London and Southeast England. Routine psoriasis treatment data from 727 patients were combined with depression and anxiety screening data from the same patients collected through the Integrating Mental and Physical Healthcare: Research Training and Services (IMPARTS) screening program. The IMPARTS programme provides a multifaceted platform of clinical and research services to assist in the integration of mental healthcare into routine care for patients with physical health conditions and is further described elsewhere (Rayner et al., 2014). At each appointment, participants filled out self-report measures of depression and anxiety using a tablet. As part of their usual care, they were then clinically assessed by their doctor. Patients could have multiple appointments during the follow-up period (between 1 and 23). To maximise the use of available data, three analytical samples were defined (Table 1) all of which had complete data on either BMI or waist circumference, on covariates (e.g., demographic, illness-related), and mental health variables (depression and anxiety). Patients with incomplete data on BMI or waist circumference, covariates (e.g., demographic, illness-related), or mental health variables (depression and anxiety) were excluded from the analytical samples.

Table 1. *The analytical samples in the analysis*

Description	Identifier	
	At time one	At follow-up
Patients with complete waist circumference data	A	B
Patients with complete BMI data	C	D
Patients with missing waist circumference and/or BMI data	E	F

Since IMPARTS data collection is part of routine clinical care, formal consent to participate is not required. Patients are told that their anonymised data may be used for research purposes (REC reference: 12/SC/0422) and that they can opt-out at any time. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline (Von Elm et al., 2007) (See Supplementary Material C).

Measures

Weight-related outcomes

Weight-related data (waist circumference [cm], height [m], and weight [kg]) are routinely collected during dermatology appointments. BMI was calculated as weight in kg divided by height in m². BMI categories were defined as healthy weight (BMI between 18.5 and 24.9 kg/m²), overweight (BMI between 25.0 and 29.9 kg/m²), obese (BMI between 30.0 and 40.0 kg/m²), and morbidly obese (BMI ≥ 40.0 kg/m²) (NHS, 2019). The threshold for healthy waist circumference was defined as < 94 cm and 80 cm for men and women, respectively (NHS, 2021). Abdominal obesity was considered as ‘present’ if the threshold was reached or exceeded.

The term ‘time one’ refers to patients’ first appointment in the database. Most participants will have had appointments before this time, preceding the data collection period. Based on data availability and completeness, a 12-month follow-up appointment was chosen to extract follow-up data (the appointment closest to 12 months was selected, within a window of 10-14 months).

Mental health

The 2-item and 9-item Patient Health Questionnaire (PHQ-2, PHQ-9) were used to screen for probable major depressive disorder (herein, depression) (Kroenke et al., 2001, 2003). The 2-item and 7-item Generalised Anxiety Disorder Scale-7 (GAD-2, GAD-7) were used to screen for probable generalised anxiety disorder (herein, anxiety) (Spitzer, Kroenke, Williams, & Lowe, 2006). Details can be found in the eMethods (See Supplementary material B).

Covariates

Covariates were selected based on theory and prior evidence and measured at time one. Demographic covariates included age, gender, and ethnicity. Because of the scarcity of routine care data from patients belonging to minority ethnic groups (19.9% of the overall patient sample), ethnicity was dichotomised into (i) White and (ii) Black, Asian, and minority ethnic (BAME). Illness-related factors included the total number of physical comorbidities (Griffiths et al., 2018), current treatment type (Warren et al., 2018), and psoriasis severity (Gisondi, Del Giglio, & Girolomoni, 2017). The number of comorbidities was calculated using routine data on the presence or absence of seven psoriasis- and obesity-related physical comorbidities (hypertension, type 2 diabetes, liver disease, bone disease, asthma, psoriatic arthritis, and cancer) (Jensen & Skov, 2016; Manzel et al., 2014). A total count of present comorbid conditions was also computed (range between 0 to 7). While comorbid depression and anxiety were recorded, these were removed from the count of comorbidities to avoid

overlap with the variables of interest, PHQ and GAD. Treatment was dichotomised as either (i) systemic therapy (treatment for psoriasis taken orally, subcutaneous, or intravenously) or (ii) no systemic treatment. This approach was taken in line with consensus that systemic therapies generally indicate more severe disease (Cohen et al., 2020) requiring more intensive treatment compared to topicals (Strober et al., 2020). Psoriasis severity was measured with the Psoriasis Area Severity Index (PASI), a clinician-rated scale for measuring the severity of psoriatic lesions based on area coverage and plaque appearance (Feldman, 2004).

Statistical analyses

There were four stages to the analysis.

First, to investigate the impact of missing data, patients with and without outcome data (waist circumference and BMI) at time one and follow-up were compared for demographic, illness-related, and mental health variables (independent-measures t-test for continuous variables and χ^2 test for categorical variables; See Tables S1 and S2 in supplementary material). Patients with available weight-related data at time one versus those with available data at follow-up were also compared (Table 3).

Second, we used correlations, χ^2 tests and t-tests to explore bivariate associations between demographic, illness-related, and mental health variables, and outcomes. This was done (i) to assess associations between variables measured at time one; and (ii) to assess associations between time one variables and outcomes at follow-up (See Table S3 in supplementary material).

Third, predictors of waist circumference and BMI were evaluated using multiple linear regression models. We estimated models to test whether depression and anxiety at time one were associated with weight-related outcomes (i) at time one and (ii) at 12 months follow-up.

All models were adjusted for demographic and illness-related covariates measured at time one. In the models using weight-related outcomes at 12 months follow-up, we did not adjust for waist circumference and BMI at time one as the preliminary analyses showed no clinically meaningful weight changes (i.e., at least a 5% reduction in weight from baseline level) (Donnelly et al., 2009). Between time one and 12 months follow-up, waist circumference showed a mean reduction of 1.8% (-0.82 cm, $p=0.163$) and BMI a mean reduction of 2.3% (-0.21 kg/m², $p=0.088$).

Fourth, using interaction terms and stratified regression models, we tested whether gender moderated the associations between depression and anxiety measured at time one with weight-related outcomes measured at (i) time one and (ii) 12 months follow-up. We included interaction terms (e.g., female gender \times anxiety) and main effects into the above regression models. The statistical significance of the interaction was tested with likelihood-ratio tests. Model fit was evaluated using a ΔF -statistic. Improvement in explained variance with each regression step was calculated using adjusted ΔR^2 . Statistical significance level was assumed at $p \leq 0.05$. All analyses were conducted in Stata 16 (College Station, 2015).

Results

Sample characteristics

There were 326 and 191 patients with available weight circumference data; and 399 and 233 patients with available BMI data at time one and follow-up, respectively. Of these, just over half (54%) had abdominal obesity based on waist circumference at time one. Most patients (75%) at time one were living with over the healthy weight, with 19% and 18% were living with obesity or morbid obesity based on BMI, respectively. At time one, depressed and anxious patients reported higher PASI and fewer comorbidities (likely due to the little

variability in the number of comorbidities) compared to those not depressed and not anxious (See Table S8 in supplementary material).

Missing data

We compared samples with available waist circumference and BMI data to those with missing waist circumference and BMI data on a variety of demographic, illness severity, and mental health measures at time one and at 12 months follow-up. This consideration allowed us to ascertain if missing data influenced the conclusions on the associations between mental health and body weight (i) at time one and (ii) at 12 months follow-up.

When looking at availability of weight-related outcome data at time one, males were significantly more likely to have available waist circumference data compared to females (males=60%; females=40%, $p=0.008$). At time one, patients who were not depressed were significantly more likely to have available BMI data than patients who presented as depressed (68% vs. 32%, $p=0.004$). There were no other differences between those with and without BMI and waist circumference data at time one (See Tables S1 and S2 in supplementary material).

When looking at availability of weight-related outcome data at 12 months follow-up, patients with missing waist circumference and BMI data at follow-up, were significantly less likely to be on systemic treatment for psoriasis compared to those not missing weight-related outcome data (27% vs. 73%, $p=0.030$) (See Tables S1 and S2 in supplementary material).

Furthermore, patients with available waist circumference and BMI data at time one had significantly higher PASI scores than patients with available waist circumference and BMI at 12 months follow-up. Table 2 summarises the patterns of missing and analytical data. Table 3

shows the demographic, illness-related, and mental health characteristics of the sample at time one and at 12 months follow-up.

Table 2. *Participant data (n) and exclusions for each analytic sample*

Excluded – waist circumference/BMI	Excluded comorbidities	Excluded treatment type	Excluded PASI
Time one sample A (n= 326)			
n=328, 45.1%	n=54, 13.2%	n=14, 3.4%	n=5, 1.2%
Follow-up sample B (n= 191)			
n=502, 69.0%	n=25, 11.2%	n=7, 3.1%	n=2, 0.9%
Time one sample C (n= 399)			
n=247, 34.0%	n=57, 11.9%	n=16, 3.3%	n=8, 1.7%
Follow-up sample D (n= 233)			
n=450, 62.0%	n=34, 12.4%	n=8, 2.9%	n=2, 0.7%

Note: Total N on IMPARTS database = 727

Table 3. *Demographic, illness-related and mental health characteristics of the analytical samples at time one and at 12 months follow-up*

		Time one (the first available data entry)		Follow-up (12 months later)		Time one vs. follow-up	
Variable		Sample A with information on waist circumference (N=326)	Sample C with information on BMI (N=399)	Sample B with information on waist circumference (N=191)	Sample D with information on BMI (N=233)	Sample A vs. Sample B	Sample C vs. Sample D
Gender, n (%)	Female	128 (31.2%)	168 (35.2%)	69 (30.9%)	89 (32.5%)	$\chi^2=0.001$,	$\chi^2=0.55$,
	Male	282 (68.8%)	310 (64.8%)	154 (69.1%)	185 (67.5%)	$p=0.943$	$p=0.458$
Age (year), mean (SD)		46.04 (13.6)	45.7 (13.3)	45.6 (12.7)	45.3 (12.9)	$t(631)=-0.44$, $p=0.662$	$t(750)=-0.33$, $p=0.742$
Ethnicity n (%)	White	333 (81.2%)	385 (80.5%)	178 (79.8%)	216 (78.8%)	$\chi^2=0.18$, $p=0.670$	$\chi^2=0.32$, $p=0.573$
	Black and Ethnic minorities	77 (18.8%)	93 (19.5%)	45 (20.2%)	58 (21.2%)		
Treatment n (%)	Systemic treatment, yes	232 (60.1%)	270 (58.7%)	144 (66.7%)	158 (59.4%)	$\chi^2=2.54$, $p=0.111$	$\chi^2=0.03$, $p=0.853$
	No systemic treatment, yes	154 (39.9%)	190 (41.3%)	72 (33.3%)	108 (40.6%)		
PASI, mean (SD)		4.7 (5.1)	4.8 (4.8)	3.4 (4.4)	3.7 (4.0)	$t(614)=-3.02$, $p=0.0027^*$	$t(738)=-3.16$, $p=0.0016^*$
Comorbidities n (%)	Diabetes	26 (6.3%)	32 (6.7%)	13(5.8%)	19 (6.9%)	$\chi^2=0.07$, $p=0.798$	$\chi^2=0.02$, $p=0.900$
	Hypertension	82 (20.0%)	110 (23.0%)	67 (24.5%)	44 (19.7%)	$\chi^2=0.01$, $p=0.935$	$\chi^2=0.20$, $p=0.654$
	Presence of liver disease, n (%)	42 (10.2%)	45 (9.4%)	24 (10.8%)	31 (11.3%)	$\chi^2=0.04$, $p=0.838$	$\chi^2=0.692$, $p=0.406$
Total number of comorbid medical conditions, mean (SD)		1.02 (1.29)	1.02 (1.32)	0.93 (1.34)	1.10 (1.35)	$t(552)=-0.75$, $p=0.451$	$t(659)=0.74$, $p=0.461$
Depression (PHQ), n (%)	Depressed	86 (20.9%)	81 (16.9%)	34 (15.2%)	42 (15.3%)		

	Not depressed	324 (79.1%)	397 (83.1%)	189 (84.8%)	232 (84.7%)	$\chi^2=3.09, p=0.079$	$\chi^2=0.33, p=0.564$
Anxiety (GAD), n (%)	Anxious	71 (17.3%)	72 (15.1%)	30 (13.5%)	32 (11.7%)	$\chi^2=1.61, p=0.205$	$\chi^2=1.67, p=0.196$
	Not anxious	339 (82.7%)	406 (84.9%)	193 (86.5%)	242 (88.3%)		
Abdominal obesity, n (%)	Obese	225 (54.8%)	347 (72.6%)	136 (61.0%)	208 (75.9%)	$\chi^2=2.20, p=0.138$	$\chi^2=0.99, p=0.319$
	Non-obese	185 (45.2%)	131 (27.4%)	87 (39.0%)	66 (24.1%)		

Bivariate associations between demographic, illness-related, and mental health (explanatory variables), and waist circumference and BMI (outcome variables)

Age and the total number of comorbidities were significantly positively correlated with waist circumference and BMI at time one. Significantly larger waist circumference was observed among males compared to females, but no difference was observed in BMI by gender. PASI scores at time one were significantly positively correlated with higher BMI, but not waist circumference, at 12 months follow-up (See Table S3 in supplementary material).

Associations between demographic, illness-related and mental health (explanatory variables), and waist circumference and BMI (outcome variables) at time one

Table 4 presents associations of mental health at time one with waist circumference and BMI at time one, adjusting for demographic and illness-related variables at time one. In the final models, there was no evidence for a significant association between depression and anxiety with waist circumference or BMI. Age ($B=0.20$, 95% CI 0.05, 0.34; $B=0.06$, 95% CI 0.02, 0.11, respectively) and the total number of comorbid medical conditions ($B=2.06$, 95% CI 0.63, 3.48; $B=.87$, 95% CI 0.42, 1.32, respectively) remained significantly associated with both waist circumference and BMI. Male gender was associated with larger waist circumference ($B=6.48$, 95% CI 2.77, 10.18), but not BMI.

The models for time one waist circumference ($F(9, 316) = 5.28$, $p \leq 0.001$) and BMI ($F(9, 389) = 5.01$, $p \leq 0.001$) were statistically significant and explained a total of 13% and 10% of variance in waist circumference and BMI, respectively. Demographic and illness-related variables explained the larger proportion of the variance in both weight-related outcomes.

Table 4. *Regression models of waist circumference and BMI as outcomes at time one*

	Waist circumference		BMI	
	<i>at time one</i>		<i>at time one</i>	
	(N=326)		(N=399)	
	B	95% CI	B	95% CI
	Step 1, R ² = 7.16%		Step 1, R ² =4.32%	
Age	0.23**	0.12-0.35	0.09**	0.05-0.12
Gender, Male	6.27**	2.94-9.60	0.16	-0.89-1.21
Ethnicity, White	0.74	-3.24-4.71	0.65	-0.60-1.94
	Step 2, R ² =11.97%		Step 2, R ² = 9.92%	
Age	0.20*	0.06-0.35	0.06*	0.02-0.11
Gender, Male	6.33**	2.64-10.02	-0.22	-1.38-0.95
Ethnicity, White	1.55	-2.66-5.76	0.88	-0.46-2.23
Comorbidities, total	1.93*	0.51-3.34	0.85**	0.40-1.30
Systemic treatment, present	1.49	-1.98-4.95	0.81	-0.30-1.93
PASI	0.32	-0.02-0.65	0.11	-0.004-0.23
	Step 3, R ² =12.57%		Step 3, R ² = 10.17%	
Age	0.20*	0.05-0.34	0.06*	0.02-0.11
Gender, Male	6.50**	2.80-10.19	-0.16	-1.33-1.02
Ethnicity, White	1.75	-2.46-5.97	0.92	-0.42-2.27
Comorbidities, total	2.06*	0.64-3.48	0.88**	0.42-1.33
Systemic treatment, present	1.79	-1.69-5.28	0.89	-0.24-2.01

PASI	0.26	-0.08-0.61	0.10	-0.02-0.22
Depression, present	3.40	-1.14-7.95	0.84	-0.75-2.44
	Step 4, R ² =12.58%		Step 4, R ² = 10.37%	
Age	0.20*	0.05-0.34	0.06*	0.02-0.11
Gender, Male	6.48**	2.77-10.18	-0.19	-1.36-0.99
Ethnicity, White	1.75	-2.47-5.97	0.86	-0.49-2.22
Comorbidities, total	2.06*	0.63-3.48	0.87*	0.42-1.32
Systemic treatment, present	1.78	-1.71-5.27	0.87	-0.26-1.99
PASI	0.26	-0.08-0.60	0.10	-0.02-0.21
Depression, present	3.90	-2.87-10.66	1.66	-0.66-3.98
Anxiety, present	-0.69	-7.69-6.31	-1.15	-3.54-1.23

Note: **p≤0.001; *p<0.05

Associations between time one explanatory variables and waist circumference and BMI measured at 12 months follow-up

Table 5 presents associations of mental health at time one with waist circumference and BMI at 12 months follow-up, adjusting for demographic and illness-related variables at time one.

We found no evidence of associations between mental health at time one and weight-related outcomes at 12 months follow-up. The total number of comorbid medical conditions was associated with both waist circumference ($B=2.28$, 95% CI 0.60, 3.95) and BMI ($B=0.66$, 95% CI 0.02, 1.30) at follow-up. Age ($B=0.28$, 95% CI 0.10, 0.45), male gender ($B=6.85$, 95% CI 2.50, 11.20), and PASI ($B=0.94$, 95% CI 0.49, 1.38), remained significantly associated with waist circumference at 12 months follow-up (Table 5).

The overall models for waist circumference ($F(9, 181) = 7.87, p \leq 0.001$) and BMI ($F(9, 223) = 2.33, p = 0.02$) at 12 months follow-up were significant, explaining a total of 30% and 8% of variance in waist circumference and BMI, respectively. Demographic and illness-related variables explained the larger proportion of the variance in both weight-related outcomes.

Table 5. *Regression models of waist circumference and BMI as outcomes at 12 months follow-up*

	Waist circumference <i>at follow-up</i> (N=191)		BMI <i>at follow-up</i> (N=233)	
	B	95% CI	B	95% CI
	Step 1, R ² = 17.44%		Step 1, R ² =4.87%	
Age	0.39**	0.25-0.54	0.09*	0.03-0.14
Gender, Male	7.39**	3.44-11.34	0.48	-0.98-1.93
Ethnicity, White	2.47	-2.14-7.08	1.07	-0.59-2.73
	Step 2, R ² =26.36%		Step 2, R ² = 7.50%	
Age	0.28*	0.10-0.45	0.06	-0.01-0.12
Gender, Male	6.67*	2.34-11.01	0.31	-1.34-1.97
Ethnicity, White	4.21	-0.64-9.07	1.23	-0.57-3.02
Comorbidities, total	2.21*	0.57-3.85	0.62*	-0.01-1.26
Systemic treatment, present	0.26	-4.01-4.53	0.54	-1.01-2.10
PASI	0.96**	0.52-1.41	0.07	-0.12-0.25
	Step 3, R ² =26.97%		Step 3, R ² = 7.59%	

Age	0.28*	0.10-0.45	0.06	-0.01-0.12
Gender, Male	6.86*	2.52-11.20	0.33	-1.33-2.00
Ethnicity, White	4.75	-0.18-9.67	1.27	-0.54-3.08
Comorbidities, total	2.29*	0.65-3.93	0.63*	-0.003-1.27
Systemic treatment, present	0.22	-4.05-4.48	0.54	-1.02-2.09
PASI	0.94**	0.49-1.38	0.06	-0.13-0.25
Depression, present	3.55	-2.11-9.21	0.54	-1.64-2.72
	Step 4, R ² =29.97%		Step 4, R ² = 7.98%	
Age	0.28*	0.10-0.45	0.06	-0.004-0.12
Gender, Male	6.85*	2.50-11.20	0.35	-1.31-2.02
Ethnicity, White	4.74	-0.21-9.68	1.26	-0.55-3.06
Comorbidities, total	2.28*	0.60-3.95	0.66*	0.02-1.30
Systemic treatment, present	0.21	-4.07-4.49	0.59	-0.97-2.16
PASI	0.94**	0.49-1.38	0.06	-0.13-0.25
Depression, present	3.82	-4.77-12.41	-0.47	-3.46-2.53
Anxiety, present	-0.37	-9.15-8.41	1.64	-1.70-4.98

Note: **p≤0.001; *p<0.05

Gender as moderator

There was no evidence of an interaction effect between gender and mental health on waist circumference and BMI at time one and follow-up in any of the models (See Tables S4-S7 in supplementary material).

Discussion

This study drew on routine care data to gain a better understanding of the role of depression and anxiety in people with psoriasis' weight-related outcomes. It adds to the small number of studies in this area by examining the association between mental health and body weight using waist circumference as a valid marker of abdominal and visceral fat (Ross et al., 2020), in addition to more commonly used BMI. The study improves on prior cross-sectional research by adjusting the analysis for several important demographic and illness-related factors, which could confound links between mental health and weight-related outcomes. In addition, this is the first study to examine these relationships over time.

Contrary to hypotheses and previous studies (Innamorati et al., 2016; Kim et al., 2014; Pavlova et al., 2021), we found no evidence of associations between depression and anxiety at time one with weight-related outcomes cross-sectionally or 12 months later, when adjusting for a wide range of demographic and illness-related factors. In line with hypotheses, we found positive associations between the number of comorbidities and weight-related outcomes cross-sectionally and 12 months later. Greater psoriasis severity at time one, measured by PASI, was also positively associated with waist circumference 12 months later. In terms of demographics, older age was positively associated with waist circumference cross-sectionally and 12 months later, and with BMI cross-sectionally only. Male gender was associated with waist circumference cross-sectionally and 12 months later, but not with BMI. Contrary to expectations, there was no moderation effect of gender on the relationship between mental health and weight outcomes.

In comparison to previous literature

Our cross-sectional findings were inconsistent with previous cross-sectional studies that reported positive associations between depression and anxiety with weight-related outcomes in psoriasis (Pavlova et al., 2021). These inconsistencies may be explained by previous studies not adjusting for the role of psoriasis severity and medical comorbidities (Bronckers et al., 2019; Innamorati et al., 2016; Pavlova et al., 2021). They may also relate to the fact that in this study we also used a cut-off to define probable caseness of depression and anxiety (Kroenke et al., 2001; Spitzer et al., 2006). Continuous measures were adopted in other research that indicated a link between depression and weight outcomes (Cohen et al., 2016). It may be that distress, rather than clinically defined categories of anxiety and depression, is associated with weight outcomes (Hanel et al., 2009; Kroenke et al., 2001).

It is also possible that both non-response and attrition biases may have played a role in the lack of association observed between depression and anxiety with weight-related outcomes (Moroshko, Brennan & O'Brien, 2011). Nearly half of participants at time one were missing information on weight-related outcomes at follow-up. Our findings indicated that people without depression were significantly more likely to have data on BMI at time one in comparison to people with depression. There was also a large amount of missing data at follow-up which may have obscured the association between depression and anxiety with weight-related outcomes.

The evidence of a positive association between older age and waist circumference at both time points, and with BMI cross-sectionally only, agrees with previous studies (Inelmen, Sergi, Coin, Miotto, Peruzza, & Enzi, 2003; Molina-Molina et al., 2020). Elderly people living with psoriasis and obesity are certainly at risk of added disability and morbidity (Inelmen et al., 2003) which should be of a particular focus in future studies. We found that

male gender was associated with waist circumference cross-sectionally and at 12 months follow-up which is consistent with previous observations that men have a relatively more central fat distribution than females (Stevens, Katz, & Huxley, 2010). This finding confirms that using solely BMI to monitor impact of increasing weight status may lead to underestimation of the associated health burden (Walls et al., 2011).

The findings that both psoriasis severity and co-morbidities are related to waist circumference and BMI are consistent with previous studies (Mahil et al., 2019; Agborsangaya, Ngwakongnwi, Lahtinen, Cooke, & Johnson, 2013). These relationships are likely to be complex and bidirectional. Multimorbidity and greater severity of psoriasis can exacerbate the physical and psychological burden of psoriasis and act as a barrier to healthy behaviours (Griffiths et al., 2018), as well as contribute to depression (Tohid, Aleem, & Jackson, 2016). Patients dealing with multimorbidity may be more prone to unhelpful coping behaviours such as social withdrawal and emotional eating, both of which have been linked to obesity and depression (Van Strien et al., 2012; Kontinen et al., 2010;2019). It is also important to consider potential mobility impairments due to multimorbidity. Disability may act as an additional barrier to healthy behaviours (Suls, Green, & Boyd, 2019), leading to reduced activity levels (Zheng et al., 2018).

Equally, excess weight may contribute to multimorbidity and more severe disease as it interferes with treatment response (Mahil et al., 2019). People with a high BMI and multiple medical conditions are more likely to report worsened psoriasis symptoms such as pain and pruritus (Bahali et al., 2017). This is important because a greater severity of psoriatic symptoms leads to an increase in the levels of depressive (Payne et al., 2018) and anxiety (Kouris et al., 2015) symptoms.

However, regardless of the physical factors, each person with psoriasis is likely to react differently to their illness-related symptoms. According to the Common-Sense Model of Self-Regulation (Leventhal, Meyer, & Nerenz, 1980), beliefs patients hold about their illness (illness perceptions) play an important role in mental and physical health outcomes (Hagger, Koch, Chatzisarantis, & Orbell, 2017). To illustrate this, a patient with normal body weight who *perceives* their psoriasis as being more severe than a patient who is overweight is more likely to suffer from low self-esteem, body image issues, and social isolation (Price et al., 2018). Patients who *self-assess* their psoriasis as severe are especially vulnerable to mental health issues (Lim, Bewley, & Oon, 2018; Carr et al., 2021). Together these perceptions can stifle physical activity and motivation to engage in healthy behaviours (Pariser et al., 2016), contributing to obesity. In a study, beliefs about psoriasis causing weight gain were linked to a higher BMI (Kim et al., 2014). Exploration of illness perceptions may reveal important information about how patients conceptualise their psoriasis and the consequences of this on their mental health and psoriasis-related behaviours, as well as weight-related behaviours (Horne & Weinman, 2002; French, Cooper, & Weinman, 2006). Future studies should investigate these underlying cognitive and behavioural factors that may better explain the high rates of obesity in psoriasis, beyond the role of depression and anxiety (Pavlova et al., 2021).

Strengths and limitations

To the best of our knowledge, this is the first study to look at the association between mental health and body weight, measured cross-sectionally and 12 months later. Compared to previous studies (Pavlova et al., 2021), the main strengths of the study are its large sample size, the adjustment for several important demographic and illness-related covariates, and the use of waist circumference as an outcome as a more accurate indication of body fat.

Despite the study's strengths, important limitations related to the use of real-world data need to be considered (Hemkens, Contopoulos-Ioannidis, & Ioannidis, 2016). The analyses were restricted to the use of dichotomised variables of depression and anxiety, indicative of probable diagnostic levels of depression and/or anxiety. This approach is likely to have obscured the association between mental health with weight-related outcomes due to reduced power (Fedorov, Mannino, & Zhang, 2009). There was substantial amount of missing weight-related outcome data (a typical characteristic of routine data) which reduced the analytical samples of patients.

Particularly given the focus on mental health and weight here, as discussed earlier, non-response and attrition biases are likely present. Although treatment type was included as a control variable within the analysis, we were unable to consider the evidence that some biologic treatments such as tumour necrosis factor alpha inhibitors, but not interleukin (IL)-12/23, may be associated with increased body weight or BMI (Ryan et al., 2015). Therefore, any possibly conflicting effects of different types of biologics on waist circumference or BMI remain future research's priority. In addition, the highly selective population sample drawn from a tertiary clinic with integrated psychological support may limit the findings' generalisability.

Conclusion

The lack of evidence linking mental health and body weight in this study suggests that obesity in psoriasis may be more directly related to comorbid conditions and severity of psoriasis. However, mental health in this study was limited to measures of probably anxiety and depression caseness. It is likely that more complex cognitive, behavioural, and emotional

factors, including beliefs and perceptions about body weight, are relevant to understanding obesity in psoriasis. People living with obesity who deal with multimorbidity and greater disease severity may be more prone to psoriasis-related unhelpful coping behaviours such as social withdrawal and emotional eating or be restricted in their physical activity due to disability. The coping and adjustment demands imposed by multimorbidity and greater disease severity, if unmet, may drive mental health issues and contribute to an increase in body weight. Future studies are needed to (i) confirm the findings using a rigorously designed longitudinal study (ii) further investigate the impact of depression and anxiety on body weight with a focus to reduce attrition among people who suffer from mental health problems and (iii) explore the role of beliefs and behaviours in the association between obesity and mental health in psoriasis.

Statement of Ethics: The research data used in this study has been granted ethical approval by the National Health Service (NHS) Research Ethics Committee in the United Kingdom (REC reference: 12/SC/0422) until 2023.

Author Contributions Statement: All authors conceived and designed the study. NP and FP performed the statistical analysis. All authors contributed to manuscript revision. All authors approved the final version of the manuscript.

Data availability statement: The data that support the findings are not publicly available due to containing information that could compromise the privacy of research participants.

END OF PUBLISHED ARTICLE

6.3. Concluding remarks

The findings from this study confirmed the assumptions of the importance of illness-related variables such as multimorbidity and psoriasis severity in relation to body weight.

Interestingly, depression and anxiety were not associated with body weight in psoriasis. This may be due to the measures used that likely indicate probable caseness of anxiety and depression; findings that were pointed by the systematic review (Chapter three) but also require further future investigations. The study pointed that it is important to explore other more complex cognitive, behavioural, and emotional factors, including beliefs and perceptions about body weight, that may be potentially relevant to understanding obesity in psoriasis, beyond the role of depression and anxiety. These assumptions set up the research objectives for the next study. It is presented in the next chapter and focuses on gaining an in-depth qualitative understanding of the beliefs and behaviours that people living with psoriasis perceive as important in the context of weight loss.

Chapter 7: ‘I don’t know which is the chicken and which is the egg’: A qualitative study of weight loss-related beliefs and behaviours among adults with psoriasis and comorbid obesity

7.1. Chapter overview

The previous chapters highlighted that most studies which investigated the role of psychosocial factors of obesity in psoriasis focused on depression and anxiety and are limited to quantitative study design. Consistently, most of these studies concluded a lack of association between depression or anxiety with body weight in psoriasis. The previous cross-sectional and longitudinal analysis, presented in Chapter six, concluded that other more complex psychosocial factors, beyond depression and anxiety, are likely to play a role in obesity in psoriasis. Qualitative methods can be particularly helpful in building an understanding of beliefs, perceptions, and motivations that underlie weight loss related behaviours from the perspective of study participants.

This chapter presents a qualitative study that aimed to gain a more comprehensive knowledge of the factors that are likely to play a role in obesity in psoriasis, including obesity-associated cognitions and perceived barriers and facilitators of weight loss in the context of obesity and psoriasis. The preferences of people living with psoriasis in relation to the design of a desired weight loss intervention were also explored. Such a consideration is likely to improve current management of obesity in psoriasis by facilitating a patient-centred approach with consideration of psoriasis-specific challenges related to weight loss.

This chapter is published in the following article:

Pavlova, N., Ramasawmy, C., Smith, C., Picariello, F., Smith, C., & Moss-Morris, R. (2022). I don't know which is the chicken and which is the egg': A qualitative study of weight loss related beliefs and behaviours among adults with psoriasis and comorbid obesity. *British Journal of Health Psychology*, [Online Version of Record](#) before inclusion in an issue.

Note: Relevant supplementary materials from this study are presented in Appendix C of this thesis.

7.2. Published article

‘I don’t know which is the chicken and which is the egg’: a qualitative study of weight loss-related cognitions and behaviours among adults with psoriasis and comorbid obesity

Perceptions of weight in psoriasis

Neli T. Pavlova, MSc¹, Celeny Ramasawmy, MSc¹, Federica Picariello, PhD¹, Catherine Smith, MD^{1, 2}, Rona Moss-Morris*, PhD¹

¹ King's College London, Health Psychology Section, Psychology Department, Institute of Psychiatry Psychology and Neuroscience, London, United Kingdom

² St John’s Institute of Dermatology, Guy’s and St Thomas’ NHS Foundation Trust, London, United Kingdom

*Corresponding author information: Rona Moss-Morris, King’s College London, Guy's Campus, Great Maze Pond, London SE1 1UL, United Kingdom, email: rona.moss-morris@kcl.ac.uk

Keywords: obesity management, psoriasis, beliefs, perceptions, unhelpful coping behaviours

Data availability statement:

The data that support the findings are not publicly available due to containing information that could compromise the privacy of research participants.

Acknowledgements:

We would like to thank all the participants in this study, as well as the Psoriasis Association and the Guy's and St Thomas' teams, for their help with recruitment and data collection.

Conflict of Interest Statement:

CS has received departmental research funding from industries that manufacture treatments for psoriasis including AbbVie, Boehringer Ingelheim, Glaxo SmithKline, Leo, Pfizer, Novartis, Regeneron, and is an investigator within consortia that have industry partners (see biomap.eu and psort.org.uk).

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What is already known on this subject?

- Weight loss offers the opportunity to reduce the significant burden of psoriasis and to improve treatment response
- Weight loss approaches in psoriasis are generic and emphasise on diet and physical activity
- Yet people with psoriasis face skin-related issues such as embarrassment that may impede their abilities to commit to the recommended weight loss behaviours

What does this study add?

- Despite the well-established link between obesity and psoriasis, people with psoriasis report a lack of understanding of the relationship between both conditions
- Weight loss advice in psoriasis needs to go beyond recommendations for diet and physical activity and include emotional support that acknowledges the psoriasis's burden
- Psoriasis-induced negative mood is often managed using unhelpful coping strategies such as comfort eating and avoidance of physical activities

Abstract:

Objectives: Obesity is a common (30-40%) comorbidity of psoriasis. Weight loss is shown to improve severity of psoriasis; however, little is known about the factors that may influence successful weight loss in the context of obesity and psoriasis. The current qualitative study aimed to explore the obesity-associated beliefs, perceptions, and behaviours related to weight loss in psoriasis. Preferences for a weight loss intervention were also explored.

Design: Qualitative in-depth semi-structured interviews with 24 adults (62.5% male) with moderate-to-severe psoriasis and obesity (Mean BMI= 35.2 kg/m², SD= 4.1), recruited through a patient organisation website in the UK. Data were analysed using inductive thematic analysis.

Results: Most participants viewed psoriasis as unrelated to obesity. A well-controlled psoriasis and improvements in psoriasis symptoms were considered as major motivators for engaging in a weight loss program by individuals who viewed psoriasis and obesity as related conditions. Comfort eating was perceived as an escape strategy from the psoriasis-induced negative emotions. Participants shared their dissatisfaction with current weight loss recommendations which were too generic. They suggested that a desirable weight loss program would require both emotional and behavioural support, with an emphasis on psoriasis's burden.

Conclusion: The findings accentuate the importance of (1) clinicians discussing the link between obesity and psoriasis with patients, (2) weight loss advice to include both behavioural and emotional support, and (3) a weight loss advice to consider the psoriasis burden and the perceived barriers which may potentially lead to improved outcomes to obesity management in psoriasis.

Introduction

Psoriasis is a complex multifactorial long-term inflammatory skin condition estimated to affect 2-4% of the population in western countries and about 2% of the UK population (Icen et al., 2009; Parisi et al., 2020). Obesity, defined as an excessive accumulation of body fat that presents a risk to health (World Health Organisation, 2022), affects one-third of people with psoriasis (Mahil et al., 2019) and has been identified as a risk factor for psoriasis onset and exacerbation (Budu-Aggrey et al., 2019; Snekvik et al., 2017). Obesity is more common among people with severe psoriasis than in those with mild disease (odd ratios of 1.55-3.05 and 1.17-1.82, respectively) (Armstrong et al., 2012; Duarte et al., 2013). Adults living with obesity and psoriasis are less likely to respond to systemic treatments than healthy-weight adults with psoriasis (Edson-Heredia et al., 2014; Naldi et al., 2008; Rodríguez-Cerdeira et al., 2019; Snekvik et al., 2019). The most frequently used tool for assessing obesity is the body mass index (BMI) of ≥ 30 kg/m² (NHS, 2019), including in psoriasis-obesity research (Pavlova et al., 2021).

To date, recommendations for treating obesity in psoriasis are driven by a predominantly biomedical understanding of weight, focusing largely on *general* behavioural interventions (i.e., reducing calorie intake and increasing physical activity) (Al-Mutairi & Nour, 2014; Chi et al., 2015; Gisondi et al., 2008; Kimball et al., 2012; Naldi et al., 2014). These behavioural interventions may play an important role in treating obesity in psoriasis. However, the same weight loss approach applied to different people is likely to yield different results (Bray et al., 2018). This is particularly relevant in the context of the varied experiences of managing psoriasis associated psychological and physical challenges. The visibility of psoriasis

symptoms may drive fear of rejection, feelings of stigmatisation, shame over the skin condition, and low mood (Auker, Cordingley, Pye, Griffiths, & Young, 2020; Pariser et al., 2016), leading to lack of self-esteem and body image issues (Nazik, Nazik, & Gul, 2017). Such experiences may hamper physical activity behaviours and motivation to eat healthily (Auker et al., 2020; Bewley, Taylor, Reichenberg, & Magid, 2014; Chao, Foy, & Farmer, 2000), both of which are associated with inability to achieve and maintain healthy body weight (Lombard, Deeks, & Teede, 2009; Pariser et al., 2016).

In the general population, the psychosocial factors that may hinder positive weight loss outcomes in people living with obesity include body image issues, high weight loss expectations, low motivation, and impaired self-confidence and perception of self (Burgess et al., 2017; Greaves et al., 2017; Grossi et al., 2006; Jung & Luck-Sikorski, 2019; Moroshko et al., 2011; Ohsiek & Williams, 2011). Weight loss is frequently cited as the key reason for engaging in behaviours that can assist in achieving a healthier weight (Ingels, Hansell, & Zizzi, 2018). However, a qualitative study conducted with 76 people living with obesity reported a broad range of motivations beyond weight loss, such as improving health, mobility, well-being, and appearance, as well as ability to spend quality time with family (Thomas, Hyde, Karunaratne, Kausman, & Komesaroff, 2008). Individual differences in perceptions of success in achieving a healthier weight and motivation to engage in relevant weight loss behaviours can be attributed, at least in part, to variances in weight-related cognitions or beliefs (Robinson, Haynes, Sutin, & Daly, 2020), which remain understudied in psoriasis (Pavlova et al., 2022).

In psoriasis, only one cross-sectional study has focused on patients' weight-related cognitions, suggesting that having psoriasis was perceived as a trigger to high BMI (Cohen et

al., 2016). Other studies that looked at obesity in psoriasis from a biopsychosocial perspective (1) are limited to quantitative, predominantly cross-sectional, studies focused mainly on depression and anxiety with no consideration of the broader psychosocial factors (Pavlova, Kioskli, Smith, Picariello, Rayner, Moss-Morris, 2021). Findings are mixed and suggest that depression and anxiety alone explain little of the variance in weight in psoriasis (Pavlova et al., 2021). This is in contrast to the well-established link between depression and anxiety and obesity in the general population (Luppino et al., 2010). Exploring other more specific psychosocial factors pertinent to psoriasis may provide novel insights into the challenges people living with psoriasis and obesity face with regards to weight loss.

Cognitions such as illness representations, symptoms perceptions, and body image often emerge as dominant constructs in quality of life and outcomes across chronic conditions such as psoriasis (Hagger & Orbell, 2003; Petrie et al., 2007). These cognitions may influence coping strategies and related outcomes (Leventhal et al., 1997; Leventhal, Watts, & Pagano, 1967), including obesity outcomes (Breland et al., 2012). For instance, people who view psoriasis as uncontrollable and as having a significantly negative impact on their life may be more prone to engaging in unhelpful behaviours such as overeating or limited physical activity that can ultimately lead to weight gain (Breland et al., 2012; Hagger & Orbell, 2003; Ogden & Flanagan, 2008). Distress related to psoriasis and/or psoriasis specific challenges may also directly influence eating behaviours (Pavlova et al., 2021; Pavlova et al., 2022). To best of our knowledge, these issues have not yet been explored.

Qualitative methods can be particularly helpful in building an understanding of the cognitions, emotions and motivations that underlie weight loss related behaviours from the perspective of study participants (Busetto, Wick, & Gumbinger, 2020; Pavlova et al., 2021).

Gaining a clearer understanding of these potentially modifiable cognitive, emotional and behavioural factors is key to improving current management of obesity in psoriasis by facilitating a patient-centred approach with consideration of psoriasis-specific challenges related to weight loss (Franz et al., 2007; Mann et al., 2007). Improving the efficacy of obesity management strategies in psoriasis (Al-Mutairi & Nour, 2014; Chi et al., 2015; Gisondi et al., 2008; Kimball et al., 2012; Naldi et al., 2014) may also provide an opportunity to improve treatment response in adults living with obesity and psoriasis who are less likely to respond to systemic treatments than healthy-weight adults with psoriasis (Edson-Heredia et al., 2014; Naldi et al., 2008; Rodríguez-Cerdeira et al., 2019; I. Snekvik et al., 2019).

The current study aimed to gain a comprehensive understanding of obesity in psoriasis required for the development of a personalised weight loss intervention by exploring: (1) obesity-associated cognitions, emotions and behaviours related to weight loss in psoriasis, (2) the perceived barriers and facilitators of weight loss in the context of obesity and psoriasis, and (3) the perceived needs and prerequisites of a weight loss intervention for adults living with obesity and psoriasis.

Method

Design

This was a cross-sectional qualitative study, using semi-structured interviews and thematic analysis. The study was approved by the West Midlands – South Birmingham Research Ethics Committee (21/WM/0118). This study followed the Standards for Reporting Qualitative Research (SRQR) reporting guideline (O'Brien et al., 2014) (See Supplementary Material).

Sample

Participants (N= 24) were recruited online through a UK-based patient organisation for people with psoriasis- the Psoriasis Association's social media outlets. Patients from the National Health Service (NHS) were contacted online and invited to participate in the study using an email letter. Participants were eligible to participate if they were: ≥ 18 years old; with a self-reported diagnosis of psoriasis; residing in the United Kingdom (UK); self-identifying as having obesity (BMI of ≥ 30 kg/m²) (NHS, 2019); with sufficient written and spoken English to take part in the interview. Exclusion criteria were if participants were unable to give informed consent or participate effectively in the interview due to any of the following: insufficient command of written and spoken English, self-reported significant learning disability or reduced cognitive capacity. Participants who self-reported any severe mental health issues such as schizophrenia, bipolar disorder, or severe depression were also excluded from the study for safeguarding reasons. Findings are presented using participants' gender (M for male; F for female) and their age (e.g., M_33).

Data collection

Potential participants were sent an email with the study information sheet and an informed e-consent to sign should they wish to participate in the study. Consented participants completed online a questionnaire, including information about their demographics (gender, age, and ethnicity), weight and height (to calculate BMI) and their psoriasis (duration of psoriasis and current treatment). The sample size of 24 participants was deemed adequate based on the recommendations, which define a sufficient sample size as one that (1) provides rich and comprehensive data and (2) is able to tell a complex and multi-faceted story about patterning related to the phenomena of interest, and (3) has the adequacy to address the research question (Braun & Clarke, 2021; Francis et al., 2010; Sim, Saunders, Waterfield, & Kingstone, 2018).

Semi-structured interviews were conducted over the phone. The interview questions were broad and open-ended (see Table 1). The interview schedule was not formulated with one specific theory in mind but was embedded in an overall cognitive behavioural understanding that cognitions, emotions, and behaviours are interlinked and influence each other. All three components can also be influenced by broader social and contextual factors, such as having an illness. We chose this broad framework as this qualitative study was part of a mixed methods approach to develop an evidence based theoretical understanding of factors associated with weight loss management in people living with psoriasis and obesity, including their understanding of how body weight impacts psoriasis. Inductive thematic analysis was conducted to ensure we elicited the patients' perspective of cognitive, emotional, behavioural, and contextual factors that hinder or promote weight loss in people living with psoriasis, rather than constrain questions and analyses to a one specific health psychology or cognitive behavioural theory. Non-directive prompts were used to follow up on leads from participants' responses. The interviews were audio-recorded with a digital device and transcribed verbatim.

Table 1. *The semi-structured interview schedule*

Interview Question

How do you see your current weight?

How do you see your weight in relation to your psoriasis?

Could you please tell me what you eat or drink on a typical day?

Is there anything in your eating routines you would like to do differently?

Could you please tell me about any physical activities that you do throughout the day?

Is there anything you would like to do differently in terms of your activity levels?

Have you ever tried to lose weight?

If yes,

- Can you please tell me your story of your most recent weight loss attempt? What did you do to lose weight?
- What has happened to your weight since then?
- Are there things that get in the way of losing weight? If yes- can you tell me more about them?
- Are there things that make it easier to manage your weight? If yes- can you tell me more about them?

If you were to engage in a weight loss intervention, what would you need from it?

What would you expect from a weight loss intervention?

If you were to get involved in a weight loss intervention, what would you like to see included?

- How should it be delivered (e.g. individually, in a group, online)?
- How often would you like to hear (if online) or meet (if in-person) from the intervention organisers about any updates or further supportive information?
- Where should it be offered- When should it be offered? –

Is there anything that you would like to tell me, that we haven't touched on?

How was it to participate in the interview?

A Psoriasis Public and Patient Involvement (PPI) group of three people provided feedback on the recruitment materials, including the study information sheet and the interview schedule, and proposed improvements were incorporated accordingly.

Data analysis

Qualitative data were analysed using inductive thematic analysis, which entails searching across a data set to identify, analyse, and report repeated patterns (themes) (Braun & Clarke, 2006) which are relevant to the description of a phenomenon associated with the research question.

The study was based on a contextualist constructionist epistemology that considers knowledge as local and situational (Jaeger & Rosnow, 1988), sustaining the idea that people see the world through the lens of certain cultural meanings and values (Creswell & Creswell, 2017). Despite the fact that subjectivity is a key component of people's stories, researchers that follow this epistemology strive to base their conclusions on the participants' real descriptions (Madill et al., 2000). In the current study, the research team's interpretation of the findings was strengthened by a mix of viewpoints from different fields (e.g., medicine and health psychology) and distinct cultural backgrounds.

The six-phase thematic analysis method was employed (Braun & Clarke, 2006), using NVivo software Version 12 (QSR International Pty Ltd., 2018). Table 2 provides details of the analysis steps and findings interpretation.

Figure 2. *List of the six-phase thematic analysis method*

Thematic analysis step	Description of the step
Step 1	Familiarisation with the data set which included reading the data repeatedly and actively (Braun & Clarke, 2006)
Step 2	Creating a coding manual to generate initial codes that are representative of significant concerns raised by the data alone (i.e., inductively) and taking notes on prospective data items of interest, questions or linkages between data items, and other preliminary thoughts (Creswell & Creswell, 2017). and producing a coding manual to generate initial codes that are representative of significant concerns raised by the data alone (i.e., inductively). The first and second writers independently coded the first 16 transcripts using the draft of the coding manual. Before updating the coding manual, the coding was compared, and similarities and differences were examined. The first and second author used the final coding manual to apply to the entire dataset, labelling data extracts with relevant codes and noting any probable patterns between items that could drive subsequent theme creation (Braun & Clarke, 2006).
Step 3	Once coding was complete, the first and second author searched for themes independently. The researcher created themes by analysing, combining, comparing, and graphically visualising how codes interact with one another (Creswell & Creswell, 2017). Candidate themes were developed and organised using thematic maps to show cross-connections between

primary themes and sub-themes, as well as their relationship to the research question (Braun & Clarke, 2006).

- Step 4 To refine themes and the thematic map, the first and the second author looked at and revised the coded data placed within each theme to ensure a proper fit (Braun & Clarke, 2006). They detailed notes regarding decisions made for theme development, modification and/or removal.
- Step 5 Each topic was given a definition and narrative description, as well as an explanation of why it is significant to the overall research question and how it ties to other themes.
- Step 6 Data extracts (i.e., anonymised quotes) that illustrate key features of the themes were selected to provide context and explain their importance in relation to the research question (Creswell & Creswell, 2017).

Findings

In total, 26 participants from the Psoriasis Association with self-reported diagnosis of psoriasis expressed their interest to participate in the study; of whom, 2 participants did not meet the inclusion criteria (BMI below 30 kg/m²). Six NHS's patients who were approached with a letter via email did not get back to the researcher to provide informed consent without providing a reason for their decision. This brings the final sample size to 24 participants.

The length of the interviews ranged from 23 to 54 minutes (Mean= 35.1 minutes, SD= 10.6).

Table 3 provides a summary of the demographic and clinical characteristics of the recruited participants.

Table 3. *Summary Table of The Demographic Characteristics Of Recruited Participants (n=24)*

Variable		Range/Percentage	
Gender, n (%)	Female	9	37.5%
	Male	15	62.5%
Age (year), mean (SD)		46.4, SD=12.1	32-66 years
Ethnicity n (%)	White	22	91.7%
	Asian	2	8.3%
Treatment n (%)	Taking systemic treatment, yes*	22	91.7%
	Taking any other, yes	2	8.3%

Psoriasis duration (in years), mean (SD)	17.6 years, SD=10.2	3-40 years
BMI kg/m ² , mean (SD)	35.2 kg/m ² , SD= 4.1	30.2 kg/m ² to 44.2 kg/m ²

* systemic treatment was defined as treatment for psoriasis taken orally, subcutaneous, or intravenously (A. D. Cohen et al., 2020), alone or in combination with other type of treatments.

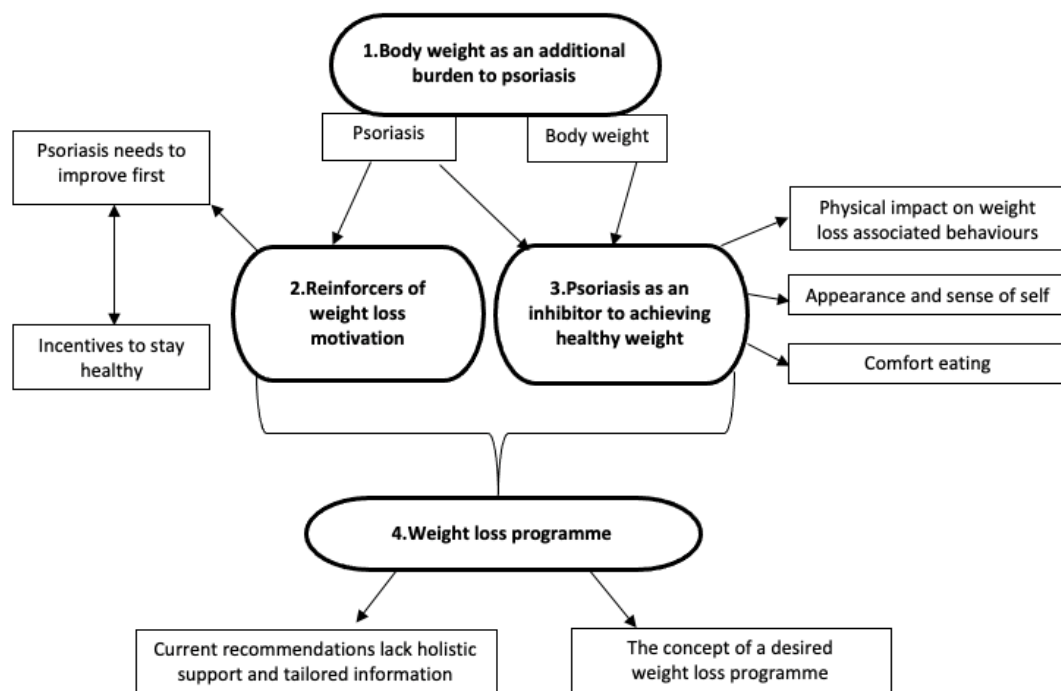
Findings from the thematic analysis

Four main themes and corresponding sub-themes were formulated through thematic analysis (Table 4) and are described in more detail below. Figure 1 is a thematic diagram of the identified themes and sub-themes with proposed possible links between the themes.

Table 4. *Summary Of the Recurrent Themes and Subthemes Across the Narratives*

Themes	Subthemes
1. Body weight in relation to psoriasis	1.1. Psoriasis and body weight are separate entities 1.2. Psoriasis and body weight are intertwined
2. Reinforcers of weight loss motivation	2.1. Psoriasis needs to improve first 2.2. Incentives to stay healthy
3. Psoriasis as an inhibitor to achieving healthy weight	3.1. Physical impact of psoriasis on weight loss associated behaviours 3.2. Appearance and sense of self 3.3. Comfort eating
4. Weight loss programme	4.1. Current recommendations lack holistic support and tailored information 4.2. The concept of a desired weight loss programme

Figure 1. *Graphical Representation of Themes and Sub-themes Identified During The Qualitative Analysis Of The Data*



1. Body weight in relation to psoriasis

This theme encompassed participants' views of the link between body weight and psoriasis.

1.1. Psoriasis and body weight are separate entities

Most participants viewed psoriasis as distinct from and unrelated to obesity, and vice versa.

Those participants were living with obesity before being diagnosed with psoriasis or observed no changes in their psoriasis when they lost weight:

"I've dropped body weight, but not seeing my psoriasis improve." [M_49]

‘The chicken and the egg’ paradox which was used to describe the uncertainty related to the perceived relationship between psoriasis and high body weight:

“I don't know if it [body weight] affects it [psoriasis]. Generally, I don't know which came first- which is the chicken, and which is the egg.” [M_55]

Most participants acknowledged their scepticism about the relationship between body weight and psoriasis and blamed it on their healthcare practitioners’ lack of thorough guidance. With no emphasis on psoriasis, weight loss was frequently promoted to participants as “*something you just need to do*” [M_61].

“I don't know if there is any link between weight and psoriasis. Nobody has spoken to me about it- it's always your BMI is too high, your weight is too high, and you need to reduce it, but it is never linked to psoriasis.” [F_42]

1.2.Psoriasis and body weight are intertwined

Only a minority of participants viewed psoriasis and body weight as linked.

“I think it [psoriasis] gets worse when you get a little bit heavier than usual- it [psoriasis] does get a bit worse.” [M_49]

“I'm sensing a little bit of psoriasis and my faulty skin, maybe when you are a little bit overweight and a little bit overhanging.” [M_65]

Participant rarely reported being advised to reduce their weight for an improvement in psoriasis:

“I hope if I lose a lot of weight, I’ll see a change [in psoriasis]. That’s what I was told at least.” [M_33]

2. Reinforcers of weight loss motivation

This theme summarises the drivers of psoriasis-related weight loss behaviours and was divided into two different sub-themes.

2.1. Psoriasis needs to improve first

The capacity to manage psoriasis and see improvements in symptoms were perceived as key incentives for initiating and continuing to engage in weight loss behaviours which links back to the intertwined nature between obesity and psoriasis (sub-theme 1.2.):

“You need to get on top of the psoriasis and feel better about yourself. Then, you have more control over your weight.” [M_55]

“I’ve been body-confident since my psoriasis has cleared through my biological treatment. Whereas I’m bigger than I would like to be, I do want to address that [the weight] now.”

[F_42]

Those with uncontrolled psoriasis hoped that if their psoriasis improved, they would feel more confident in their own skin, which in turn would enhance their desire to lose weight:

“If my psoriasis improves then my motivation to lose weight would be higher. If I was in a better place with psoriasis, it would make me feel better within myself. If you feel physically better, then you will feel mentally better.” [M_36]

2.2. Incentives to stay healthy

Sustained improvement in psoriasis was described as a key incentive to adopting any changes that can support weight loss:

“I don’t think there’s anything I would know to do differently but I would be willing to almost do anything differently if it helped psoriasis long-term.” [M_33]

More general anticipated weight loss benefits, such as improved quality of life, well-being when aging and appearance, and spending quality time with family were also perceived as key motivators to lose weight:

“I feel like I have to control [my weight] because I want a good quality of life as I get older. I want to be able keep up with my grandchildren” [F_35]

“I don’t want to be that person when I get older. I’d like to be fit.” [F_42]

There was a positive feedback loop, with participants describing improved mental and physical wellbeing following weight reduction, translating into fewer psoriasis flares, which further reinforced motivation to continue with the weight loss efforts:

“I managed to break free and lose weight. And that made me feel better and my anxiety went down, my stress went down, and my flare ups went down.

I’ll eat healthy.” [M_49]

3. Psoriasis as an inhibitor to achieving healthy weight

This theme encapsulates psoriasis-associated factors that made engagement in weight loss associated behaviours such as healthy eating and increased physical activity difficult. It was divided into three sub-themes.

3.1. Physical impact of psoriasis on weight loss associated behaviours

The physical impact of psoriasis was seen as a significant barrier to healthy eating and physical activity.

Pain and the burden of other symptoms related to psoriasis were perceived as reasons to isolate from social activities and to have no motivation to consume healthy foods:

“Why would I feed myself well?! Sometimes the pain is so strong that I just want to suppress it with sugar- it gives me endorphins”. [M_65]

Most participants were unable to adhere to an exercise plan due to the unpredictable nature of psoriasis:

“I think psoriasis is so unpredictable. I can’t really plan to do a daily exercise routine, because I don’t know how I’m going to be in the morning.” [M_65]

Exercise was thought to induce discomfort in the skin's afflicted regions and was perceived as difficult for those with comorbid psoriatic arthritis due to the additional joint discomfort. This physical discomfort was seen as a major impediment to weight loss:

“I’ve got type of arthritis associated with it [psoriasis] which has affected my joints quite badly. And it's made exercising quite difficult. And so, my weight has gone up and then I am struggling to get fit and lose it.” [F_35]

“I can’t exercise very much now, because I have it [psoriatic arthritis] on my hands and feet. I used to go out walking, but it’s [hands and feet] quite painful.” [M_36]

Participants reported that the aftereffects of systemic treatment for psoriasis interfered with their intentions to eat healthily and stay active:

“The treatment I take for my psoriasis takes a day out of my week. Basically, because the after-effects are so strong that I can’t exercise or eat particularly well.” [M_33]

As opposite to the lack of perceived controllability of psoriasis, the perceived the capacity to manage its physical burden were perceived as key weight loss motivators (sub-theme 2.1) and thus may pre-determine engagement in weight loss associated behaviours.

3.2.Appearance and sense of self

Because psoriasis was believed to be visible by others and triggered embarrassment, most participants, particularly women, said they lacked confidence to engage in appearance-based physical activities like swimming.

“They say: ‘go swimming - that’s good for you and everything’, but then it’s my confidence – going swimming. Getting in a swimming costume- I haven’t got the confidence to do that.” [F_45]

Despite the perceived appearance constraints, a handful of participants were able to overcome this challenge, motivated by the anticipated improvements in their physical health, which links back to theme reinforcers of weight loss motivation (theme 2) with perceived improvements in psoriasis facilitating further weight loss behaviours:

“I am going to the pool every morning. It is quite difficult because you look quite weird to everybody so, it is stressful doing it, but it is good for my joints, and it is turning me up. Physically, I feel a lot better.” [F_35]

These perceptions link back to the perceived incentives to stay healthy (sub-theme 2.2.) which entailed anticipations that weight loss may improve appearance, body image and overall mental health alongside the associated physical benefits such as flare-ups reduction.

In addition to the perceived psoriasis-related psychological barriers to a healthy way of living, some participants believed that their low self-esteem and negative self-perceptions due to their high weight, in addition to psoriasis, reflected how others saw them:

“You’re running on the street and passing by people’s houses, and everyone is looking at you. It just put me off a bit.” [F_35]

3.3.Comfort eating

For most participants, psoriasis was perceived as the root of negative affect which triggered the desire to consume unhealthy foods as a strategy to create a comfort space, away from the negative emotions. These perceptions further confirmed the intertwined views of body weight and psoriasis (sub-theme 1.2.).

“Because of your skin, it [feeling down] makes you crave these carbohydrate and sugary foods. I’ve covered up a lot of my emotions due to my psoriasis for 15-20 years and my coping mechanisms have been with food to sort of numb the feelings.” [M_35]

“If I had a bad week then the skin under my eyebrows will flare up and that brings more stress and anxiety. And makes me want to eat more food to make me feel better.

It’s a bit of a cycle, I can see it but it’s about getting out of it.” [M_49]

Participants described unhealthy foods improving their mood in the short-term, but all of them expected that eating processed foods high in sugar and fats would aggravate their psoriasis.

“If I do have a week or two where I just eat rubbish and not making healthy choices, I’ve noticed that my psoriasis can be worse than normal” [F_45]

“When you eat sugar, you have all of these endorphins floating around your body, you get an immediate relief, but it tends to diminish overtime” [M_62]

4. Weight loss programme

4.1. Current recommendations lack holistic support and tailored information

Most participants described a mismatch between their weight loss advice needs and the care received from healthcare practitioners:

“I do feel a bit unsupported by dermatologists and the GP. No one's ever linked lifestyle factors to psoriasis. It's always been creams, light treatment and if it's that bad then there's medication you can take.” [M_35]

Uncertainty about weight loss was a product of lack of guidance on nutrition and physical activity. Participants expressed a need for personalised advice on how to improve their nutrition while acknowledging the challenges of psoriasis:

“It would be nice for other people to say: ‘this is the information, these are some websites, there's this person in the community that can help you with your diet and try to discuss the matter [weight and psoriasis] with you’. If there's no one to talk to about it [weight and psoriasis], I feel quite lonely. I don't know what to do.” [M_49]

These views link back to the perceived physical impact of psoriasis on weight loss associated behaviours (sub-theme 3.1.) that highlight the physical burden of the disease.

When weight loss advice was provided by a healthcare practitioner, it predominantly revolved around required behavioural modifications such as increased physical activity and improved eating routines. Participants expressed frustration that the difficulties of dealing with psoriasis were left underrecognised, alongside unresolved feelings (e.g., stress and low mood) that were seen as the root of participants' weight gain.

“I had post-traumatic stress disorder and other stresses, but nobody ever mentioned those. As a result, I started eating and drinking that may have contributed to my weight and my body image.” [F_42]

These experiences link back to the appearance constraints and the emotional challenges of psoriasis (sub-theme 3.2.) and the unhelpful behaviours such as emotional eating which follow because of them (sub-theme 3.3.).

4.2. Preferred weight loss programme

People living with psoriasis emphasised three key components essential to tailored weight loss programmes. These included: (i) emotional support to help them cope with the disease induced negative emotions and experiences; (ii) dietary and physical activity guidance that fits around living with psoriasis and leads to improvements in skin condition; and (iii) social support to allow for exchanges of experience with other people living with psoriasis who aiming to lose weight. Table 5 provides an overall summary of patients' preferences for a weight loss programme.

Table 5. *Preferred weight loss programme*

Component	Aims and sub-components
Emotional support	<p>Aim: To facilitate the initiation and maintenance of weight loss associated behaviours by addressing:</p> <ul style="list-style-type: none"> • Ways in which to manage psoriasis-induced negative emotions • Emotional eating
Behavioural support	<p>Aim: To facilitate the initiation and maintenance of weight loss associated behaviours through:</p> <ul style="list-style-type: none"> • Guidance on portion control and balanced eating that fits around living with psoriasis • Goals-setting around physical activity and health eating as long as it leads to improvements in skin condition • Weight loss guidelines that do not over restrict social activities and conder psoriasis burden
Social support	<p>Aim: To allow for experience exchange and support in the journey through</p> <ul style="list-style-type: none"> • Online support sessions • Weekly check-ins with intervention organisers

Participants expressed their needs for “*a focused rather than a general approach*” [M_33] to weight loss, with structured and clear guidance on portion control and balanced eating that fits around living with psoriasis.

“If I am given instructions- I tend to follow them precisely. I suppose, if I have a diet and exercise routine set of instructions, I will follow them.” [M_62]

Emotional support (e.g., counselling or referral to mental health services) was described as an essential component for inclusion in a weight loss programme to address the perceived emotional challenges (e.g., psoriasis-induced negative emotions) and associated behaviours (e.g., emotional eating) (sub-themes 3.2. and 3.3.).

“Helping me understand or helping me deal with some things [experiences] that I’ve been through before. I think they affected my eating and my emotions and why I eat the way I do.” [F_41]

“Having that extra support for people that are struggling- like with me. I think a lot of it [weight] is in my head. My anxiety stopped me [from losing weight].” [F_45]

Participants also stressed the importance of being listened to by a healthcare practitioner for improving their mood and ultimately their eating routines.

“The better you feel about yourself, the better you want to eat. That’s why is so important to have someone to talk to” [F_41]

In terms of the desired behavioural support, most participants agreed that the inclusion of clear goals would reinforce their motivation to stick to the weight loss plan.

“The goal-setting and goal-checking were really important in [weight loss] things I’ve done previously. I really like stages you can follow or complete, or progress. ‘Badges’ you can unlock, and you can win” [M_33]

“If I have a particular challenge to walk, for example, 1000 yards a day, I will make a conscious effort to do that.” [M_62]

The pitfalls of losing weight, as well as the achievements, were seen as crucial elements to include in the intervention material.

“You know that motivation when somebody says: ‘you can do this’. Alongside with the guidance if you’re doing the right thing.” [M_55]

Most participants who had previously participated in weight loss programs had difficulty achieving the desired weight and maintaining it afterwards, owing to the dietary restrictions and the burden of psoriasis which *“kills my motivation to keep up with losing weight when it [psoriasis] is out of control” [F_55]*. Dieting was perceived to interfere with social life and induced feelings of guilt when breaking a diet due to social occasion.

“You can sustain that [dieting] for so long and then it starts to create stress. It is making you feel dread seeing your friends. It is really obsessive, and it makes you feel really terrible if you haven’t had a very good week [of eating].” [F_41]

“As long as I could have coffee in the morning, I think I would be alright. I can’t think of anything else that springs to mind.” [M_55]

All participants who were open to engage in a weight loss intervention if offered to them emphasised on the crucial role of having social support.

“If there are other people on it [the intervention], you could compare ideas or things like that. So, it could have a positive psychological effect on your weight” [M_33]

The importance of the social aspect was also evident in the preferred delivery mode for the intervention, with over half of the participants expressing interest in an online group format.

“Online because my sort of lifestyle is hard for me to commit to time away from where I live. Online makes things easier for me.” [F_42]

“Online you can e-meet with people. Exchange ideas and experiences. Share how the week has gone for you.” [F_55]

Most participants anticipated that once-a-week check-ins by intervention facilitators would keep them on track with the intervention content.

“If I had to report to somebody every week what my weight was and what I have done or what I haven’t done. I quite like that; I have always been fairly measured in that sort of thing.” [M_62]

Overall, the preferred weight loss programme is reflective of participants' experiences captured in theme 2 (reinforcers of weight loss motivation) and theme 3 (psoriasis as an inhibitor to achieving healthy weight) and includes the requirements to address behavioural and emotional challenges related to psoriasis.

Discussion

The overarching aim of this study was to explore the obesity-associated cognitions, emotions and behaviours related to weight management in people living with psoriasis and obesity. Preferences for a weight management intervention were also explored. Most participants viewed psoriasis as distinct from and unrelated to obesity, with only a minority considering the two conditions as interlinked. The key reasons for engaging with a weight-loss program for people who viewed psoriasis and obesity as connected conditions were well-controlled psoriasis and anticipated weight-loss generated benefits such as improved psoriasis symptoms, quality of life, and well-being. Because of its physical and emotional burden, psoriasis was viewed as an important barrier to weight loss related behaviours. Comfort eating was perceived as an escape strategy from psoriasis-induced negative emotions. Participants shared their dissatisfaction with the current weight loss recommendations which fail to address their needs holistically in consideration of the idiosyncratic challenges of psoriasis. People living with psoriasis felt an ideal weight loss programme should provide emotional support for the challenges of living with psoriasis, opportunities for shared experiences of weight loss attempts and challenges with others living with psoriasis, and behavioural strategies such as dietary and physical activity guidance that fits around living with psoriasis and leads to improvements in skin condition.

Despite the well-established link between obesity and psoriasis (Mahil et al., 2019), this is the first study to report a lack of understanding of the relationship between both conditions from the perspective of people living with psoriasis. As outlined in the Self-Regulatory Common-Sense Model of illness, the lack of a coherent and accurate understanding of an illness may compromise an individual's selection of self-management activities and treatment-seeking behaviours such as weight loss programs (Leventhal, Leventhal, & Breland, 2011). A qualitative study with 41 people with psoriasis in the UK showed that poor understanding and expectations about psoriasis limit social interaction and interferes with relationships quality (Dures et al., 2017). Another qualitative study confirmed this conclusion, claiming that psoriasis stigma led people to develop strategies to avoid public exposure and social situations (Khoury, Skov, & Møller, 2017). In the current study, avoidant strategies were also reported in the context of weight loss-related behaviours such as publicly engaging in exercise; findings that are also consistent with previous literature (Byrne et al., 2006; Klein et al., 2004; Rolls, 2012).

To escape from the negative mood triggered by pain and uncertainty surrounding psoriasis symptoms, participants in this study comforted themselves with palatable and unhealthy foods and abandoned certain physical activities, such as swimming. These behaviours are also reported by people living with chronic pain (O'Loughlin & Newton-John, 2019), including psoriasis (Auken et al., 2020; Cather et al., 2017). Comfort eating could improve participants' psoriasis-related negative mood immediately, but the perceived benefits tended to diminish shortly after, followed by other negative emotions (e.g., guilt) and anticipated weight gain (Konttinen, Silventoinen, et al., 2010; Konttinen, Van Strien, Männistö, Jousilahti, & Haukkala, 2019; O'Loughlin & Newton-John, 2019). Although comfort eating is often seen in the context of increased appetite which is an atypical symptom of depression

(American Psychiatric Association, 1980; Levitan et al., 2012; Ohayon & Roberts, 2015), depression alone may be insufficient to understand weight in psoriasis (Pavlova et al., 2021). The association between depression and body weight may be moderated by emotional eating (Goldschmidt, Crosby, Engel, et al., 2014; Konttinen, Männistö, et al., 2010; Konttinen, Silventoinen, et al., 2010; van Strien et al., 2016) and should be explored further in a quantitative study.

Psoriasis and weight loss perceptions were featured strongly throughout participants' narratives and shaped the response to the weight reduction behaviours such as engagement in- or avoidance of healthy eating and physical activity. This is consistent with the growing evidence on the role of illness perceptions across outcomes and long-term conditions (Hagger & Orbell, 2003; Ogden & Flanagan, 2008). A meta-analytical review of research with cardiac patients demonstrated that patients with strong perceived disease controllability and positive views of their treatment were more likely to attend their cardiac rehabilitation (French, Cooper, & Weinman, 2006). Addressing cardiac patients' illness perceptions was also linked to reduced pain and time away from work (Petrie et al., 2002). Together these findings suggest that the views of people with psoriasis about disease controllability and their expectations of the effectiveness of a weight-loss intervention may be used to augment existing behavioural obesity treatments (Breland et al., 2012).

Alongside the general weight loss needs and requirements such as flexibility in routines, regular eating and portion control (Joki, Mäkelä, & Fogelholm, 2017), participants also reported the need to address their psoriasis-specific needs. Despite that psoriasis is objectively recognised as a reasonably stable skin condition when compared to atopic eczema (Schmitt, Meurer, Klon, & Frick, 2008), participants in this study viewed it as unstable. They

reinforced the need to recognise the physical and psychological impact of psoriasis, such as skin-related embarrassment when engaging in physical activity, as part of the preferred weight loss programme. Weight loss was viewed as a very difficult goal since the psoriasis treatment routine is already a source of stress and may prevent people from engaging in behaviours that can benefit their weight (Meneguín, de Godoy, Pollo, Miot, & de Oliveira, 2020). These findings indicate the need to view psoriasis and obesity as interconnected that require multidisciplinary attention, including psychological and nutritional support (Meneguín et al., 2020). As such, it may be valuable to address the mismatch between participants' expectations for weight loss support and the advice provided by healthcare practitioners (Feldman et al., 2016). The presence of a medical explanation provides a greater likelihood that psoriasis will be better understood and may be manifested in a greater perceived coherence and control with respect to psoriasis and weight loss; perceptions that may lead to the adoption of supportive weight loss related behaviours (Hagger & Orbell, 2003).

Clinical implications

Healthcare practitioners can discuss the link between high body weight and psoriasis with respect to disease severity and treatment response (Budu-Aggrey et al., 2019; Snekvik et al., 2017). The physical and psychological burden of psoriasis and people's emotional well-being are likely to be leading factors in their motivation to lose weight (Nelson et al., 2014). This is aligned with the NICE guidelines (NICE, 2014) on psoriasis stipulating the importance of prioritising people's psychological well-being in any treatment regimen. The findings from this study confirmed people's preferences for an individualised weight loss approach that goes beyond the biomedical needs and acknowledges the emotional well-being in the context of the psoriasis burden (Khoury et al., 2017). Previous weight loss intervention studies in

psoriasis (Al-Mutairi & Nour, 2014; Chi et al., 2015; Gisondi et al., 2008; Kimball et al., 2012; Naldi et al., 2014) focused on a generic behavioural approach (i.e., low calorie interventions and increasing physical activity) with no acknowledgement of the required physical and psychological impact of psoriasis. Consequently, standard weight loss behavioural strategies could be enhanced by cognitive techniques that address psoriasis-related stress and negative body image. Such an approach can reduce weight loss treatment attrition to support long-term maintenance of behaviours for sustained weight loss (Dalle Grave, Calugi, et al., 2020; Dalle Grave et al., 2014).

Limitations of the current study and future directions

This study has several limitations. Psoriasis disease activity varies and can impact on cognitions and behaviours related to weight loss. The present interview study captured cognitions in a single data collection session which are not reflective of how perceptions and behaviours related to weight management may differ when psoriasis is active versus when under control. Regardless of our efforts to extend recruitment to a wider range of ethnic groups, the sample was predominantly white. Our findings do not therefore include the views of participants living with psoriasis from other ethnic groups. Moreover, the recruited participants were recruited online, and their experiences may differ to people with psoriasis that would have been recruited through hospital settings, underlying the need to validate the current findings using clinical populations. We were unable to explore whether participants' cognitions and behaviours related to body weight differ based on clinical indicators such as psoriasis severity due to the self-reported method of data collection. However, more than 90% of the recruited participants were taking systemic therapy that suggested a moderate-to-severe population which is likely seen in hospital settings. The population sample in this study has had no current access to a weight loss intervention which further limits the

generalisability of the findings. Obesity was assessed using BMI of $>30 \text{ kg/m}^2$ which prevented us from differentiating between body fat mass and muscle mass (Luz, Barbosa and d'Orsi, 2016); whereas a higher percentage of body fat mass is associated with poor physical and mental health outcomes (Speed et al., 2019). Incorporating a more accurate indicator of body fat such as waist circumference, alongside BMI, may allow for more precise understanding of the associated physical and emotional burden of psoriasis and obesity (Luppino et al., 2010; Pavlova et al., 2021).

Future quantitative and qualitative studies are needed to explore whether the factors identified in this study vary depending on disease activity in a more ethnically diverse sample. In the next stage of this work, we aim to operationalise the key themes using existing cognitive, emotional, and behavioural quantitative measures where possible and to explore specific associations between these variables and weight-related outcomes in people living with obesity and psoriasis. These data can be drawn together to help inform future weight loss interventions for people living with obesity and psoriasis. In light of the mixed evidence on the association between depression and obesity in psoriasis and the use of emotional eating as a strategy observed here, we will explore the role of emotional eating as a moderator of the association between depression and body weight in psoriasis (van Strien et al., 2016). These qualitative and quantitative data can be drawn together to help inform future weight loss interventions for people living with obesity and psoriasis.

Conclusion

Our findings suggest people with psoriasis and obesity may not be sufficiently informed about the link between high body weight and psoriasis severity. Comfort eating was perceived as a strategy to manage the psychological and physical burden of psoriasis which

may ultimately prevent weight loss. The perceptions of psoriasis uncontrollability were also identified as a challenge for committing to weight loss related behaviours. The perceptions of skin-related embarrassment and the fear of being judged based on the skin and body appearance also triggered unhelpful behaviours such as avoidance of physical activities. Clinicians can (1) aim to explore people's illness representations and associated behaviours and (2) acknowledge their preferences for tailored weight loss advice that goes beyond exclusively behavioural approaches and appreciates the emotional well-being and self-concept/esteem in the context of the psoriasis burden.

END OF PUBLISHED ARTICLE

7.3. Concluding remarks

The findings from the current study contributed to the lack of any qualitative evidence that focuses on the role of psychosocial factors of obesity in psoriasis, as suggested by the systematic review (Chapter three). The study also contributed to the lack of theoretically informed studies in the area of obesity in psoriasis by embedding the study design in an overall cognitive behavioural understanding that cognitions, emotions and behaviours are interlinked and influence each other. The theoretical consideration that all these three components can be influenced by broader social and contextual factors, such as having an illness, was also made. The findings from the study suggested a lack of coherent understanding of the link between psoriasis and obesity. Feelings of powerlessness in the face of psoriasis and perceived barriers to weight loss due to the serious consequences of the skin condition and its chronic and cyclical nature were also reported. Emotional eating was seen as a strategy to cope with the physical and psychological burden of psoriasis. Together these qualitative findings set up the objectives for the next study, presented in Chapter eight, that aimed to conduct quantitative investigations of these cognitive and behavioural factors in relation to body weight in psoriasis. The need to conduct additional research to investigate the role of depression and anxiety in body weight and psoriasis was also addressed in this subsequent study.

Chapter 8: Emotional eating and illness perceptions, but not depression and anxiety, are associated with high body weight in psoriasis: cross-sectional study

8.1. Chapter overview

The qualitative findings presented in the previous chapter demonstrated that perceived lack of coherent understanding of the link between psoriasis and obesity. Feelings of powerlessness in the face of psoriasis and perceived barriers to weight loss due to the perceived serious consequences of the skin condition and its chronic and cyclical nature were also reported. Emotional eating was seen as a strategy to cope with the physical and psychological burden of psoriasis. These findings align with the previous studies conducted within this thesis assuming that other more complex psychosocial factors, beyond depression and anxiety, are likely to play a role in obesity in psoriasis. Yet, due to the acknowledged methodological flaws, these findings require further investigation.

This chapter presents a quantitative study that aimed to investigate the association between the cognitive, emotional, and behavioural factors that emerged from the qualitative findings with body weight in psoriasis, using theoretically informed questionnaires. In particular, the study examined the associations between psoriasis and body weight illness perceptions and emotional eating with two weight related outcomes, BMI and waist circumference. In addition, the associations between depression and anxiety with body weight were also investigated, taking into account the previously identified methodological flaws, including using more comprehensive assessment tools such as PHQ-8 and GAD-7 (rather than PHQ-2 and GAD-2 that were used in the cross-sectional and longitudinal analysis) and controlling for several demographic, lifestyle, and illness-related variables.

This chapter has been submitted for consideration for publication published in the journal of *Psychology & Health*.

Note: Relevant supplementary materials from this study are presented in Appendix D of this thesis.

8.2. Article in consideration for submission for publication

Emotional eating and illness perceptions, but not depression and anxiety, are associated with high body weight in psoriasis: a cross-sectional study

N. T. Pavlova ¹, F. Picariello ¹, C. Smith ³, A. Jones ¹, A. Yalcinkaya ¹, R. Moss-Morris ^{1*}

¹ Health Psychology Section, Psychology Department, Institute of Psychiatry Psychology and Neuroscience, King's College London, London, United Kingdom

² Guy's and St Thomas' NHS Foundation Trust, St John's Institute of Dermatology, London, United Kingdom

*Corresponding author information: Rona Moss-Morris, King's College London, Guy's Campus, Great Maze Pond, London SE1 1UL, United Kingdom, email: rona.moss-morris@kcl.ac.uk

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Availability of data and materials: The data that support the findings are not publicly available due to containing information that could compromise the privacy of research participants.

Key words: obesity management, psoriasis, illness perceptions, emotional eating

Abstract

Obesity is common in people with psoriasis and is associated with sub-optimal treatment responses. Little is known about the cognitive and behavioural factors that may influence successful weight loss in the context of obesity and psoriasis. The current cross-sectional study investigated the association between illness perceptions, depression, anxiety, and emotional eating with body mass index (BMI) and waist circumference, after adjusting for demographic, lifestyle, and illness-related factors. Adults with psoriasis were recruited online through patient organisations in the United Kingdom. Participants (N=167), with mean BMI of 33.8 kg/m² (SD = 7.9), completed validated questionnaires assessing putative cognitive, emotional, and behavioural factors. Self-reported data on weight, height, and waist circumference, and on demographic, lifestyle, and illness-related factors were also collected. Emotional eating was positively associated with both BMI and waist circumference. Perceiving psoriasis as chronic and self-managing psoriasis and high body weight as two separate conditions were positively associated with BMI only. Depression and anxiety were not associated with BMI and waist circumference. The findings accentuate the importance of encouraging integrated self-management of psoriasis and obesity by emphasising the link between both conditions and offering support to deal with emotional eating by providing information on more helpful coping techniques.

Introduction

Psoriasis is a chronic debilitating inflammatory skin condition that affects 2-9% of the world's population (Parisi et al., 2013). The impact of psoriasis on mental and physical health is well-documented (Armstrong et al., 2012; Dalgard et al., 2015; Khalid et al., 2013; Łakuta & Przybyła-Basista, 2017; Wu, Mills, & Bala, 2009). A third of people living with psoriasis have comorbid obesity (Mahil et al., 2019), defined as an excessive accumulation of body fat that presents a risk to health (Iskandar et al., 2015). Obesity is more common among people with severe psoriasis than those with mild disease (odds ratios of 1.55-3.05 and 1.17-1.82, respectively) (Armstrong et al., 2012; Duarte et al., 2013) and has been linked to sub-optimal treatment response (Bardazzi et al., 2010; Edson-Heredia et al., 2014; Naldi et al., 2008; Rodríguez-Cerdeira et al., 2019; Snekvik et al., 2019). Both psoriasis and obesity frequently co-occur with depression and anxiety in a bi-directional manner, where obesity may drive mental health issues and vice versa (Innamorati et al., 2016; Kim et al., 2014; Luppino et al., 2010; Pavlova et al., 2021). This co-occurrence may be due to the emotional and physical challenges that psoriasis and comorbid obesity have on patients' lives (Griffiths et al., 2018; Kouris et al., 2015). Pain, discomfort, difficulty performing daily tasks, and low self-esteem are common symptoms of both psoriasis and obesity (Griffiths et al., 2018; Martínez-Ortega et al., 2019).

Obesity management is a potentially important adjuvant to current psoriasis treatments due to the psychological and physical challenges associated with high body weight in psoriasis, including its impact on treatments efficacy (Samarasekera & Smith, 2014; Upala & Sanguankeo, 2015). To date, weight loss interventions have been based on general behavioural weight loss models that focused on dietary habits and physical activity (Al-

Mutairi & Nour, 2014; Del Giglio et al., 2012; Gisondi et al., 2008; Guida et al., 2014; Jensen et al., 2013; Kimball et al., 2012). Findings from these studies suggest a direct link between weight reduction, improved treatment response, and reduction in psoriasis severity in the short-term, however, if these positive effects can be maintained overtime remains unknown (Kisielnicka et al., 2020; Mahil et al., 2019). Failure to address the complex and multifactorial aetiology of obesity observed in the general population has been known to lead to weight regain in the long term (Franz et al., 2007; Mann et al., 2007). Tailoring an illness-specific weight loss intervention to address the unique challenges of weight loss while living with psoriasis may be more effective in the long-term (Clark et al., 2004; Peckmezian & Hay, 2017a). Developing such an intervention, however, would require targeting the cognitive, emotional, and behavioural factors that are associated with high BMI. Previous studies in other patient populations indicated that such factors may affect people's abilities to adhere to the weight loss recommendations in the long-term (Gray et al., 2009; Morgan et al., 2013). Thus, cognitive, emotional, and behavioural factors relevant to the context of high body weight and psoriasis remain an investigative priority.

Depression and anxiety are associated with high BMI and are known key barriers to engagement with and adherence to weight-loss recommendations in the general population (Mazzeschi et al., 2012; Somerset et al., 2011). In psoriasis, however, evidence to date suggests weak or null associations between depression and anxiety and body weight (Pavlova et al., 2021; Pavlova et al., 2022). This may be because of limitations in these studies, including measurement issues and failure to control for confounding variables. For example, previous studies have dichotomously reported depression and anxiety, indicative of probable diagnostic levels (Pavlova et al., 2021; Pavlova et al., 2022), which may have obscured the reported associations with weight-related outcomes due to reduced power (Fedorov et al.,

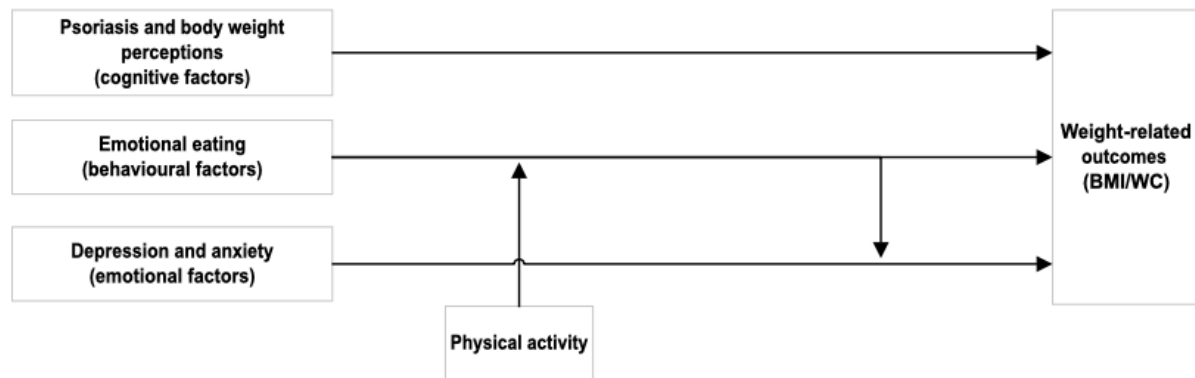
2009). A recent qualitative study (Pavlova, Ramasawmy, Picariello, Smith, & Moss-Morris, 2022) uncovered other possible complex psychological factors related to body weight, including illness perceptions and coping behaviours, that have not been examined in existing quantitative studies in psoriasis (Pavlova et al., 2022). These included feelings of powerlessness in the face of psoriasis and perceived barriers to weight loss due to the serious consequences of the skin condition and its chronic and cyclical nature (Pavlova et al., 2022). Participants described uncertainty and a lack of clarity regarding the link between psoriasis and obesity; perceptions that have been linked to impaired quality of life in a previous cross-sectional study in psoriasis (Solmaz, Ilhan, & Bulut, 2021).

Previous qualitative research also indicated that overeating may be used to cope with the burden and associated negative emotions of living with psoriasis (Chisholm et al., 2016). Eating in response to negative emotions, termed emotional eating (van Strien & Bazelier, 2007), has been described as a way to mentally escape from the psoriasis induced negative mood (Chisholm et al., 2016; Pavlova et al., 2022). Emotional eating has been shown to moderate the association between depression and anxiety with body weight in the general population (Goldschmidt, Crosby, Engel, et al., 2014; Kontinen, Männistö, et al., 2010; Kontinen, Silventoinen, et al., 2010; van Strien et al., 2016), suggesting the potential impact of this construct on weight loss behaviours. If these findings are confirmed in psoriasis, providing support to learn other strategies to reduce low mood, may decrease tendencies to use food as an affect regulation strategy. In the general population, regular physical activity has also been shown to moderate the experienced negative mood and distress typically observed among people who eat emotionally. Ultimately physical activity has been shown to lead to reduced emotional eating behaviours (Dohle, Hartmann, & Keller, 2014; Koenders & van Strien, 2011) and reduced body weight (Koenders & van Strien, 2011).

Qualitative findings suggested several perceived physical and psychological barriers to physical activity in psoriasis (Pavlova et al., 2022). Physical activity induced sweat may exacerbate psoriasis symptoms. Embarrassment related to visibility of psoriasis plaques and the high body weight may prevent people living with psoriasis and obesity from being active (Pavlova et al., 2022). Whether physical activity attenuates the relationship between emotional eating and body weight remains to be investigated in psoriasis.

To address some of the gaps in the literature identified above, the overall aim of this study was to investigate the association between cognitive (psoriasis and body weight perceptions), emotional (depression and anxiety), and behavioural factors (emotional eating) and body weight, using BMI and waist circumference as outcomes. Two further objectives explored possible moderators of the associations: (1) emotional eating as a moderator of the association between depression/anxiety and BMI and waist circumference, and (2) physical activity as a moderator of the association between emotional eating and BMI and waist circumference. Associations were explored, controlling for possible factors which have been associated with obesity including demographic (e.g., age and gender), lifestyle (e.g., smoking status, alcohol intake) and illness-related variables (e.g., treatment type and number of comorbidities). The following hypotheses were formulated and are outlined in Figure 1.

Figure 1. Proposed associations between predictors and weight-related outcomes



1a. Stronger beliefs that psoriasis is a chronic and cyclical illness with serious consequences, greater perceived lack of understanding of the link between psoriasis and high body weight, and greater tendency to self-manage psoriasis and high body weight as two separate conditions will be positively associated with higher BMI and waist circumference, after controlling for demographic, lifestyle, and illness-related variables.

1b. Higher levels of depression, anxiety and emotional eating will be positively associated with higher BMI and/or waist circumference, after controlling for demographic, lifestyle, and illness-related variables.

2. Emotional eating will be a significant moderator of the association between depression and anxiety with BMI and/or waist circumference, after controlling for demographic, lifestyle, and illness-related variables; where the association between depression and anxiety and with BMI and/or waist circumference will be stronger for those with a higher tendency to engage in emotional eating.

3. Physical activity will be a significant moderator of the association between emotional eating with BMI and/or waist circumference, after controlling for demographic, lifestyle, and illness-related variables, where the association between emotional eating with BMI and/or waist circumference will be stronger for those with lower levels of physical activity.

Methods

Design

This was an observational cross-sectional study with data collected at a single time point from each participant. The study was approved by the King's College London Research Ethics Committee (RESCM-21/22-25743). Informed consent was obtained from all participants. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline (Von Elm et al., 2007).

Sample

Participants (N= 167) were recruited online from December 2021 to July 2022, using social media sites for people with psoriasis living in the United Kingdom (UK) -The Psoriasis Association and The Psoriasis and Psoriatic Arthritis Alliance. Participants were eligible to participate if they were: ≥ 18 years old; with a self-reported diagnosis of psoriasis; residing in the UK; able to self-report height and weight; with sufficient written and spoken English to provide informed consent and complete the questionnaires. Participants who self-reported any severe mental health issues such as schizophrenia, bipolar disorder, or severe depression were excluded from the study for safeguarding reasons.

Data collection

Potential participants accessed an online link via the Qualtrics questionnaire platform (Qualtrics, Provo, UT) which provided a screen with the study information e-sheet and an informed e-consent to sign should they wish to participate in the study. Consented participants completed an eligibility questionnaire, based on the inclusion and exclusion criteria. Once eligibility was confirmed, participants were asked to 1) provide height, weight,

and waist circumference, 2) provide sociodemographic (age, gender, ethnicity, marital status, living conditions, level of education, employment status), illness-related (years living with psoriasis, comorbidities, current psoriasis treatment), and lifestyle data (smoking status, alcohol intake frequency), and 3) to complete a set of questionnaires used to operationalise the constructs of each hypothesis (measures detailed below). Upon completion of the questionnaires, participants were thanked for their participation and were provided with Weight Watchers contact details for weight loss support.

Weight-related outcomes

Participants self-reported their height (m) and weight (kg) measurements. BMI was calculated as weight (kg) divided by the square of their height (m²). BMI was categorised as healthy weight (BMI between 18.5 and 24.9 kg/m²), overweight (BMI between 25.0 and 29.9 kg/m²), obese (BMI between 30.0 and 40.0 kg/m²), and morbidly obese (BMI \geq 40.0 kg/m²) (NHS, 2022). To measure abdominal obesity, participants self-reported if their waist circumference was below thresholds of ≥ 88 and ≥ 102 for females and males, respectively (Janssen, Katzmarzyk, & Ross, 2002). Participants could also enter their exact waist circumference measurements in inches or centimetres in a free-text box. As only two participants chose to provide their exact waist circumference, waist circumference outcomes reported here are the self-reported dichotomised data regarding being below or above abdominal obesity thresholds.

Psoriasis Illness Perceptions

Three subscales from the Illness Perception Questionnaire Revised (IPQ-R) that measure beliefs about psoriasis timeline including its chronicity (acute/chronic timeline), and cyclical

nature (cyclical timeline), and the serious consequences of psoriasis (consequences), were used here. Items are scored on five-point Likert scale from 0 (Strongly disagree) to 4 (Strongly agree). Higher scores represent stronger perceptions. The IPQ-R has been extensively used in long-term conditions, including in psoriasis (Bulat, Šitum, Delaš Aždajić, Lovrić, & Dediol, 2020; Kirby et al., 2001; Noormohammadpour et al., 2015; Solmaz et al., 2021), where it has demonstrated good psychometric qualities $\alpha \geq 0.79$ to 0.89 across all subscales (Moss-Morris et al., 2002). The subscales in the current study demonstrated acceptable internal consistency, ranging from $\alpha = 0.72$ to $\alpha = 0.89$, except for the consequence items subscale that demonstrated poor internal consistency of $\alpha = 0.51$.

Psoriasis and Body Weight Illness Perceptions

Two subscales from the Diabetes and Depression Representation and Management Questionnaire (DDRMQ) (Mc Sharry et al., 2015) which was designed to assess patients' perceptions about the interrelationship between diabetes and depression were adapted to capture illness perceptions of both psoriasis and body weight in the current study. The terminology was changed from 'diabetes' to 'psoriasis' and 'depression' to 'body weight'. The two subscales were (1) perceived lack of understanding of the link between psoriasis and high body weight and (2) self-managing psoriasis and high body weight as two separate conditions. Total scores for each subscale range from 1 to 20. Higher scores on the relationship between psoriasis and body weight scale suggest less understanding of the link between both conditions. Higher scores on self-managing psoriasis and obesity as two separate conditions represent beliefs that each condition should be managed separately. The adapted scales had good internal consistency, in line with the original questionnaire, $\alpha = 0.72$ to 0.86.

Depression

The Patient Health Questionnaire-8 (PHQ-8) is an 8-item measure of depression symptoms over the past two weeks. Items are scored on a four-point Likert scale from 0 (Not at all) to 3 (Nearly every day). Total scores range from 0 to 24, with higher scores indicating higher levels of depressive symptoms (Kroenke et al., 2001; Spitzer et al., 2006). The following cut-off scores are used: 0-3: 'normal' or 'minimal' depression; 4-8: 'mild' depression; 9-13: 'moderate' depression; 14-18: 'moderate-severe' depression; and 19+: 'severe' depression. The PHQ-8 was selected over the PHQ-9 because of its comparable psychometric performance, while allowing the exclusion of the item capturing suicidal ideation ('thoughts that you would be better off dead or of hurting yourself in some way') (Shin et al., 2019). Given the online nature of the study and limited opportunity for support provision and follow-up, this consideration was deemed the most appropriate. The PHQ has been widely used in long-term conditions, including psoriasis (Lamb et al., 2017; Pavlova et al., 2021; Kroenke et al., 2001; Spitzer et al., 2006) (Dbouk et al., 2008; Monahan et al., 2009; Williams et al., 2005). The PHQ-8 has previously demonstrated good internal consistency ($\alpha \geq 0.82$) (Kroenke et al., 2001; Spitzer et al., 2006), which was replicated in the current sample ($\alpha = 0.85$).

Anxiety

The Generalised Anxiety Disorder Scale-7 (GAD-7) is a 7-item measure of anxiety symptoms over the past two weeks. Items are scored on a four-point Likert scale from 0 (Not at all) to 3 (Nearly every day). Total scores range from 0 to 21, with higher scores indicating higher levels of anxiety symptoms (Kroenke et al., 2001; Spitzer et al., 2006). The following cut-off scores are used of: 0-5 : 'mild' levels of anxiety; 10-14 : 'moderate' levels of anxiety; and 15+ : 'severe' levels of anxiety (Kroenke et al., 2001; R. L. Spitzer et al., 2006). The

GAD-7 has previously demonstrated good internal consistency ($\alpha \geq 0.83$) (Kroenke et al., 2001; Spitzer et al., 2006), which was replicated in the current sample ($\alpha = 0.96$).

Emotional Eating

The Dutch Eating Behaviour Questionnaire (DEBQ) is a 33-item scale assessing three distinct eating behaviours in adults (Van Strien et al., 1986), including an emotional eating sub-scale which was utilised in the current study. Items on the emotional eating subscale are scored on a five-point Likert scale from 1 (Never) to 5 (Very often). Total scores range from 13 to 65, with higher scores indicating higher levels of emotional eating. DEBQ has been used in weight management research in patient populations such as diabetes (Hays et al., 2014), but has not yet been validated in psoriasis. The DEBQ has previously demonstrated excellent internal consistency ($\alpha \geq 0.95$) (Hays et al., 2014), which was replicated in the current sample ($\alpha = 0.96$).

Physical activity

Levels of physical activity were assessed via the 4-item Godin-Shephard Leisure-Time Physical Activity Questionnaire (Godin, 2011). The first three items assess the frequency of engaging in mild, moderate, and strenuous physical activity of at least 15 minutes in a typical week by providing examples for each intensity category. Derived scores include total weekly physical activity, in which number of bouts at each intensity are multiplied by 3, 5, and 9 metabolic equivalent and summed. Total scores categorise individuals into active and insufficiently active categories according to published physical activity guidelines for public health (Dale et al., 2016; Garber et al., 2011). The Godin-Shephard Leisure-Time Physical Activity Questionnaire has been previously used in people with long-term conditions (Amireault & Godin, 2015; Morres et al., 2021).

Confounders

Self-reported data on confounders included demographic, lifestyle, and illness-related factors. These were selected based on the bivariate associations and prior evidence focusing on the association of obesity, depression, and anxiety in psoriasis or in the general literature (Adışen, Uzun, Erduran, & Gürer, 2018; Fluharty, Taylor, Grabski, & Munafò, 2016; Pavlova et al., 2022; Sullivan, Fiellin, & O'Connor, 2005; Wootton et al., 2020). Demographic confounders included age, gender, and ethnicity. Females and people older in age may be particularly at risk for impaired mental health and obesity (Golpour et al., 2012; Liao et al., 2020). Because of the scarcity of data from participants belonging to black, Asian and minority ethnic (BAME) groups (13.2% of the overall patient sample), ethnicity was dichotomised into (i) White and (ii) people from ethnic minority backgrounds.

Illness-related factors included the total number of physical comorbidities (Griffiths et al., 2018), current treatment type (Warren et al., 2018), and years living with psoriasis (Gisondi et al., 2017). People receiving topical treatments, and those with severe psoriasis and multiple comorbid conditions may also be more likely to report lower mental health and higher weight (Golpour et al., 2012; Liao et al., 2020). The list of comorbidities which respondents could select from were those known to relate to both psoriasis and obesity (psoriatic arthritis, asthma, hypertension, cancer, thyroid disease, diabetes type 2) (Jensen & Skov, 2016; Manzel et al., 2014). A total count of present comorbid conditions was computed (range 0-6).

Treatment was dichotomised as either (i) systemic therapy (treatment for psoriasis taken orally, subcutaneous, or intravenously) or (ii) no systemic treatment. This approach was taken in line with consensus that systemic therapies generally indicate more severe disease (Cohen et al., 2020) requiring more intensive treatment compared to topicals (Strober et al., 2020).

Respondents self-reported the number of years they had been living with psoriasis in an open text-box, which was analysed continuously.

Lifestyle factors included smoking status and alcohol consumption, both known as risk factors for depression and obesity in the general population (Sullivan et al., 2005; Traversy & Chaput, 2015). There is also evidence that both lifestyle factors are associated with psoriasis onset and greater disease severity (Adışen et al., 2018). Lifestyle factors were dichotomised based on variations in weight outcomes by the categories using one-way ANOVAs with the Games-Howell method for posthoc comparisons to mitigate the risk of type 1 error due to multiple testing (Sauder & DeMars, 2019). Based on the analysis, smoking status was categorised into (i) smoker and (ii) ex-smoker or non-smoker, whereas alcohol consumption was categorised into (i) at least twice a week or more and (ii) less than once a week or never.

Sample size determination

A prior power calculation using G*Power version 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007) indicated that a minimum sample size of $n = 167$ would be sufficient to detect a medium R^2 effect size = 0.15 (based on previous studies (Pavlova et al., 2022), with a power of 0.80 at a two-tailed alpha level of 0.05 (Kang, 2021).

Statistical analysis

Data were summarised using descriptive statistics. There were four stages to the analysis. First, we used independent measures t-test (for continuous variables) and χ^2 test (for categorical variables) to investigate the impact of missing data. Demographic, lifestyle, and illness-related data were compared between patients with complete data and those with missing data on any cognitive, emotional, and behavioural factors.

Second, to assess bivariate associations between cognitive, emotional, behavioural, demographic, lifestyle and illness-related variables, and outcomes, correlations, χ^2 tests, t-tests, and one-way ANOVAs were used. Due to non-normality of continuous data,

bootstrapping was applied, which meant that random samples were drawn based on the observed dataset to estimate sampling distribution (Wright, London, & Field, 2011). As such, the bootstrap was used to improve the finite-sample performance and to reduce the bias of estimators and errors in the coverage probabilities of confidence intervals due to non-normality and high kurtosis (Horowitz, 1998).

Third, multiple linear regression models were used to evaluate whether cognitive (illness perceptions), emotional (depression and anxiety), and behavioural (emotional eating) factors were associated with weight-related outcomes (BMI and waist circumference). All models were adjusted for demographic, lifestyle, and illness-related covariates.

Fourth, interaction terms were used to test whether (i) emotional eating moderated the association between depression and anxiety with BMI and/or waist circumference; and (ii) physical activity moderated the association between emotional eating with BMI and/or waist circumference. The statistical significance of the interactions was tested with likelihood-ratio tests.

Model assumption checks, including multivariate normality of residuals, influential outliers, and multicollinearity were used. Multiple regression models with a calculation of robust standard error were used to protect against deviations of homoscedasticity (Garson, 2012).

Model fit was evaluated using a ΔF -statistic. Improvement in explained variance with each regression step was calculated using adjusted ΔR^2 . Statistical significance level was assumed at $p \leq 0.05$. All analyses were conducted in Stata 16 (College Station, 2015).

Results

Sample characteristics

231 people accessed the survey link, of whom 222 consented and were eligible to participate (96.1 %). Of those consenting and eligible, 167 people (87.9%) had complete data. The flow of recruitment and data collection is shown in Figure 2. Tables 1 and 2 provide a summary of

the demographic, lifestyle, and illness-related characteristics and the cognitive, emotional, and behavioural factors of the sample, respectively.

Figure 2. *Study recruitment flow diagram*

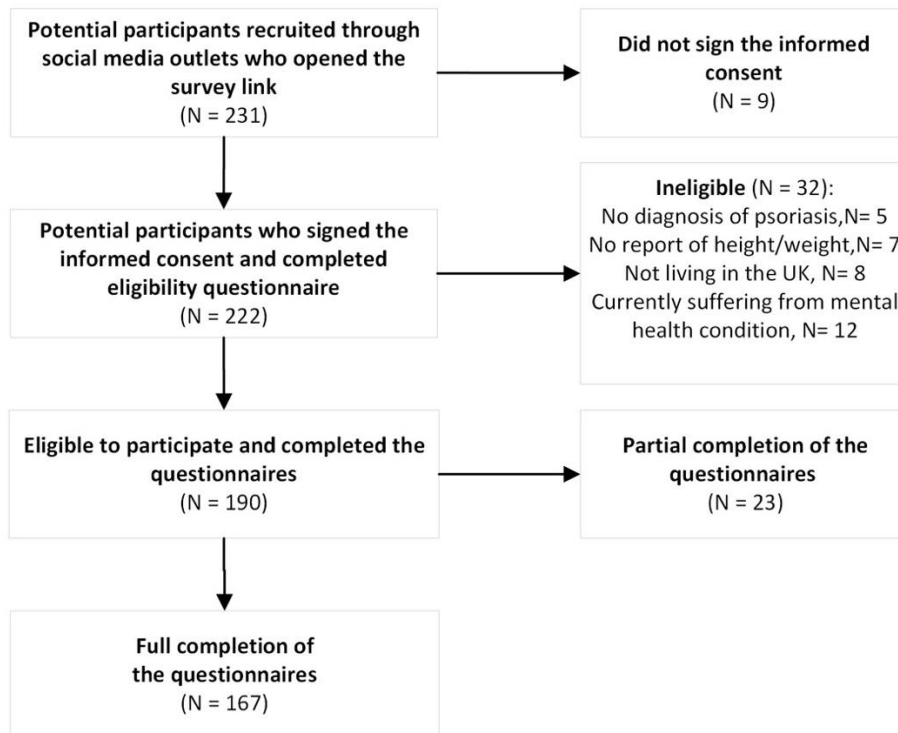


Table 1. *Summary Table of the Demographic, Lifestyle, and Illness Characteristics of Recruited Participants (N=167)*

Variable		N= 167	Range
Gender, n (%)			
		129 (77.2%)	
Female			
Age (year), mean (SD)		46.04 (13.6)	20-75
Total number of comorbid medical conditions, mean (SD)		2.0 (1.40)	0-6
Marital status, n (%)	Married/living with a partner	74 (44.3%)	
Ethnicity, n (%)			
White background		145 (86.8%)	
Black and other ethnic minorities		22 (13.2%)	
Employment status, n (%)	Unemployed/retired/unable to work	40 (23.9%)	
Higher education, n (%)	Higher education	105 (62.9%)	
Smoking status, n (%)	Smoker	60 (35.9%)	
Alcohol, n (%)			
At least 2 times a week or more		68 (40.7%)	
Once a week/never		99 (59.3%)	
Previous weight loss attempts, n (%)	Yes	159 (95.2%)	
Years living with psoriasis, n (%)	More than 10 years	94 (56.3%)	
Treatment, n (%)	Systemic treatment	75 (44.9%)	
Total number of comorbid medical conditions, mean (SD)		2.0 (1.40)	0-6
Body Mass Index (BMI), mean (kg/m²) (SD)		33.8 (7.9)	19.8-65.01
Abdominal obesity, n (%)	Obese	118 (70.7%)	
What worries you most, n (%)			
Psoriasis		19 (11.4%)	
Obesity		19 (11.4%)	
Both psoriasis and high body weight		108 (64.7%)	
Other medical conditions		21 (12.6%)	
What affects your life most, n (%)			

Psoriasis	24 (14.4%)
Obesity	19 (11.4%)
Both psoriasis and high body weight	99 (59.3%)
Other conditions	25 (15.0%)

Table 2. *Summary Table on the Cognitive, Emotional, and Behavioural Factors of Recruited Participants (N=167)*

<i>Variable</i>	<i>N= 167</i>	<i>Range</i>
<i>Cognitive factors (illness perceptions)</i>		
<i>Timeline beliefs - psoriasis as a chronic condition (IPQ), mean (SD)</i>	22.6 (7.0)	0-30
<i>Timeline beliefs - psoriasis as a cyclical/unpredictable condition (IPQ), mean (SD)</i>	12.9 (4.5)	0-20
<i>Beliefs about the serious consequences of psoriasis (IPQ), mean (SD)</i>	20.7 (5.7)	0-30
<i>Perceived lack of understanding of the link between psoriasis and high body weight (DDRMQ), mean (SD)</i>	13.2 (2.4)	0-20
<i>Self-managing psoriasis and high body weight as two separate conditions (DDRMQ), mean (SD)</i>	10.2 (4.2)	0-15
<i>Behavioural factors</i>		
<i>Emotional Eating Score (DEBQ), mean (SD)</i>	47.4 (12.7)	14-65
<i>Physical activity, mean (SD)</i>	50.2 (55.6)	0-270
<i>Emotional factors</i>		
<i>Depression (PHQ-8), mean (SD)</i>	8.9 (4.9)	0-18
<i>Anxiety (GAD-7), mean (SD)</i>	9.5 (7.2)	0-21

Missing data

Twenty-three participants did not have complete data, with missingness presented exclusively on the psychological questionnaires (Figure S1 for the specific distribution of missingness by questionnaire). We compared samples with complete data (N= 167) and those with missing data on any cognitive, emotional, and behavioural factors (N= 23). The consideration of systematic differences between those with complete data and those without was important to ascertain the likely impact of missingness on results. No differences were observed between those retained in analysis and those missing (Table S1).

Bivariate associations between cognitive, emotional, and behavioural factors (explanatory variables), BMI and waist circumference (outcome variables)

Perceiving psoriasis to be chronic, perceived lack of understanding of the link between psoriasis and high body weight, and emotional eating were significantly positively correlated with both BMI and waist circumference. Female gender, being a smoker, perceiving psoriasis as cyclical/unpredictable condition with serious consequences, self-managing psoriasis and high body weight as two separate conditions, perceptions that having both psoriasis and high body weight affected life the most and increased worry, were significantly positively correlated with BMI, but not waist circumference. Table 3 provides a summary of the correlations.

Table 3. Exploratory bivariate associations between predictors and outcomes

Predictors	Outcomes	
	BMI	Waist circumference
Demographic and illness-related factors		
Age	r= -0.05, p=0.55	r= 0.06, p= 0.47
Gender, female	r= 0.19, p=0.01*	$\chi^2= 1.00$, p= 0.61
Ethnicity	r= -0.01, p=0.88	$\chi^2= 3.01$, p= 0.83
Marital status	r= -0.03, p= 0.74	$\chi^2= -0.03$, p= 0.66
Living conditions	r= -0.02, p=0.76	$\chi^2= 0.06$, p= 0.46
Level of education	r= 0.05, p=0.50	$\chi^2= 0.02$, p= 0.78
Employment status	r= -0.05, p=0.50	$\chi^2= 0.01$, p= 0.92
Smoking status, smoker	r= 0.32, p< 0.001*	$\chi^2= -0.01$, p= 0.89
Alcohol intake	r= 0.07, p= 0.37	$\chi^2= 0.03$, p= 0.74
Previous weight loss attempts	r= -0.04, p= 0.60	$\chi^2= 1.44$, p= 0.165
Years living with psoriasis diagnosis	r= 0.06, p= 0.45	$\chi^2= -0.12$, p= 0.12
Psoriasis treatment type, systemic	r= 0.02, p= 0.78	$\chi^2= 3.19$, p= 0.061
Number of comorbidities	r= 0.11, p= 0.16	$\chi^2= 1.12$, p= 0.14
Cognitive factors (illness representations)		
Timeline beliefs - Psoriasis chronicity (IPQ-R)	r= 0.21, p= 0.007*	$\chi^2= 4.10$, p= 0.04*
Timeline beliefs – Cyclical/unpredictable condition (IPQ-R)	r= 0.13, p= 0.08	$\chi^2= 2.34$, p= 0.13
Serious consequences (IPQ-R)	r= 0.19, p= 0.01*	$\chi^2= 1.15$, p= 0.13
No understanding of psoriasis and high body weight link (DDRMQ)	r= 0.28, p= 0.005*	$\chi^2= 4.58$, p= 0.04*
Separate management of psoriasis and high body weight (DDRQM)	r= 0.31, p= 0.004*	$\chi^2= 1.02$, p= 0.49
Both conditions lead to high affect (DDRQM)	r= 0.28, p= 0.006*	$\chi^2= 1.21$, p= 0.26
Both conditions lead to worry (DDRQM)	r= 0.25, p= 0.03*	$\chi^2= 1.18$, p= 0.21
Behavioural factors		
Emotional eating	r= 0.27, p= 0.008*	$\chi^2= 6.17$, p= 0.04*
Physical activity	r= 0.04, p= 0.62	$\chi^2= 2.15$, p= 0.81
Emotional factors		
Depression (PHQ-8)	r= 0.05, p= 0.51	$\chi^2= -1.12$, p= 0.37
Anxiety (GAD-7)	r= 0.07, p= 0.38	$\chi^2= -1.38$, p= 0.19

Note: Psoriasis chronicity = Beliefs about psoriasis chronicity; Cyclical condition = Beliefs psoriasis is a cyclical and unpredictable condition (IPQ-R); Serious consequences = Beliefs about the serious consequences of psoriasis (IPQ-R); No understanding of psoriasis and high body weight link = Perceived lack of understanding of the link between psoriasis and high body weight (DDRMQ); Separate management of psoriasis and high body weight = Self-managing psoriasis and high body weight as two separate conditions (DDRQM); Both

conditions lead to high affect = perceptions of having both conditions affected life the most (DDRQM); Both conditions lead to worry = perceptions of having both conditions increased worry (DDRQM).

Associations between cognitive, emotional, and behavioural factors (explanatory variables), and BMI and waist circumference (outcome variables)

Table 4 presents associations of cognitive, emotional, and behavioural factors with BMI and waist circumference, adjusting for demographic, lifestyle, and illness-related variables.

The demographic, lifestyle, and illness-related variables explained 10.5% and 7.9% of the variance in BMI and waist circumference, respectively. The psychological factors contributed an additional 15.2% and 7.1% to the variance explained in BMI and waist circumference, respectively. Overall, the final models for both weight-related outcomes were significant, explaining 25.7% of the variance in BMI and 15.0% of the variance in waist circumference. In the final model, emotional eating was significantly positively associated with both BMI and waist circumference – with every one-point increase in emotional eating, there was 0.17 kg/m² increase in BMI and 0.01 cm increase in waist circumference. Perceiving psoriasis as chronic condition and self-managing psoriasis and high body weight as two separate conditions were significantly positively associated with BMI only – with every one-point increase in perceiving psoriasis as chronic condition and self-managing psoriasis and high body weight separately, there was 1.17 kg/m² and 1.31 kg/m² increase in BMI, respectively. Female gender and being a smoker were associated with higher BMI (3.02 kg/m² and 2.49 kg/m², respectively) compared to male gender and non-smokers or ex-smokers, while people identifying as from a White ethnic background reported significantly lower BMI (-4.98 kg/m²) when compared to those from other ethnic backgrounds. None of the demographic, lifestyle or illness-related variables were associated with waist circumference in the final models.

Table 4. Regression Model of Body Mass Index (BMI) and Waist Circumference as Outcome Variables

Outcome	BMI				Waist circumference			
	Step 1		Step 2		Step 1		Step 2	
Effect	B (95% CI)	p	B (95% CI)	p	B (95% CI)	p	B (95% CI)	
(Constant)	30.310 (23.741, 36.872)	<0.001	33.122 (26.862, 41.544)	<0.001	1.482 (1.051, 1.911)	<0.001	2.063 (1.463, 2.672)	
Age	-0.052 (-0.169, 0.065)	.379	-0.046 (-0.169, 0.078)	.467	0.003 (-0.004, 0.009)	0.399	0.003 (-0.003, 0.009)	
Gender	3.362 (0.557, 6.167)	.0191	3.015 (0.435, 5.594)	.022	-0.045 (-0.195, 0.106)	0.557	-0.038(-0.194, 0.119)	
Ethnicity	-3.349 (-6.41, -0.289)	.032	-4.984 (-8.757, -1.212)	.01	-0.118 (-0.28, 0.044)	0.152	-0.063 (-0.222, 0.096)	
Smoking status	1.785 (0.318, 3.252)	.0172	2.493 (0.779, 4.207)	.005	-0.027 (-0.11, 0.056)	0.516	-0.044 (-0.132, 0.045)	
Alcohol	-0.019 (-0.761, 0.724)	.962	-0.33 (-1.07, 0.409)	.379	0.046 (-0.002, 0.094)	0.063	0.05 (-0.001, 0.100)	
Years with psoriasis	0.589 (-0.296, 1.473)	.191	0.424 (-0.68, 1.535)	.453	-0.038 (-0.092, 0.016)	0.116	-0.031 (-0.092, 0.030)	
Systemic treatment	0.254 (-2.107, 2.615)	.832	1.332 (-0.986, 3.65)	.258	-0.116 (-0.266, 0.034)	0.128	-0.157(-0.304, -0.01)	
Comorbidities	-0.179 (-1.332, 0.975)	.761	-0.20 (-1.341, 0.941)	.73	0.031 (-0.032, 0.091)	0.320	0.026 (-0.035, 0.086)	
Timeline beliefs - Psoriasis chronicity			1.172 (-1.206, 2.351)	.038*			-0.010 (-0.024, 0.005)	
Timeline beliefs – Cyclical/unpredictable condition			0.185 (-0.159, 0.529)	.29			-0.008 (-0.025, 0.009)	
Serious consequences			0.219 (-0.137, 0.575)	.226			0.003 (-0.017, 0.022)	
No link understanding			-0.141 (-0.305, 0.023)	.091			0.001 (-0.008, 0.010)	
Separate management			1.312 (0.084, 2.539)	.036*			-0.025 (-0.127, 0.076)	
Emotional eating			0.171 (0.034, 0.308)	.015*			0.007 (0.013, 0.002)	
Depression			0.231 (-0.167, 0.629)	.253			-0.014 (-0.037, 0.010)	
Anxiety			-0.142 (-0.389, 0.104)	.256			0.012 (-0.006, 0.029)	
	R ²	Sig. F change	R ² (R ² Change)	Sig. F change	R ²	Sig. F change	R ² (R ² Change)	
PV	10.5%	0.005	25.7% (15.2%)	0.009	7.9%	0.005	15.0% (7.1%)	

Note: Gender = Gender, female; Ethnicity = Ethnicity, White; Alcohol = Alcohol, at least twice a week or more; Years with psoriasis = Years living with psoriasis, total; Systemic treatment = Systemic treatment, present; Comorbidities = Comorbidities, total; Psoriasis chronicity = Beliefs about psoriasis chronicity; Cyclical condition = Beliefs psoriasis is a cyclical and unpredictable condition (IPQ-R); Serious consequences = Beliefs about the serious consequences of psoriasis (IPQ-R); No understanding of psoriasis and high body weight link = Perceived lack of understanding of the link between psoriasis and high body weight (DDRMQ); Separate management = Self-managing psoriasis and high body weight as two separate conditions (DDRQM); PV = predictor variable

Emotional eating as moderator of the association between depression and anxiety (explanatory variables) with waist circumference and BMI (outcome variables)

There was no evidence of an interaction effect between emotional eating and depression or anxiety on BMI ($B = -0.001$, 95% CI $-0.028, 0.026$, $p = 0.952$) or waist circumference ($B = -0.001$, 95% CI $-0.002, 0.001$, $p = 0.099$) (Tables S2 and S3 in supplementary material).

Physical activity as a moderator of the association between emotional eating (explanatory variables) with waist circumference and BMI (outcome variables)

There was no evidence of an interaction effect between physical activity and emotional eating on BMI ($B = 0.001$, 95% CI $-0.003, 0.002$, $p = 0.782$) or waist circumference ($B = 0.001$, 95% CI $0.001, 0.002$, $p = 0.744$) (Tables S4 and S5 in supplementary material).

Discussion

The current study added to the limited previous literature in this area by examining cognitive, emotional, and behavioural factors related to body weight in psoriasis. This is the first study to show that emotional eating is positively associated with both BMI and waist circumference in people with psoriasis. It is also the first to show that perceiving psoriasis to be chronic in nature and self-managing psoriasis and high body weight as two separate conditions were positively associated with BMI. Other illness perceptions such as perceiving psoriasis to have serious consequences and being cyclical in nature, and a perceived weaker understanding of the link between psoriasis and high body weight were not associated with body weight. Consistent with previous findings, the current results suggest no association between depression or anxiety and weight-related outcomes in this sample of people living with psoriasis (Pavlova et al., 2021; Pavlova et al., 2022). Contrary to expectations, moderation effects of (i) emotional eating on the relationship between mental health and weight outcomes

and (ii) physical activity on the relationship between emotional eating and weight outcomes were not observed.

It may be that the emotional eating occurs more in response to a wide range of negative emotions linked to psoriasis such as frustration, embarrassment, and shame rather than anxiety and depression *per se*. These broader emotions and emotional eating may also link to beliefs about the chronicity of psoriasis which were related to weight outcomes. Food is often used as emotion regulation and stress coping strategy in the general population (Loeber et al., 2018; Spoor et al., 2007). Previous literature has suggested that people living with high body weight and psoriasis may use food high in fat and sugar to cope with psoriasis-induced negative emotions (Leventhal et al., 1997; Leventhal et al., 1998; Spoor et al., 2007).

Emotional eating may improve psoriasis-associated negative mood in the short-term, however, the perceived benefits may diminish shortly after, and ultimately lead to increased negative affect (e.g., sadness and guilt) (Haedt-Matt & Keel, 2011) and the risk of increased body weight (Konttinen, Silventoinen, et al., 2010; Konttinen et al., 2019; O'Loughlin & Newton-John, 2019). According to the Common-Sense Model of Self-Regulation (Leventhal et al., 2011), illness perceptions may influence how people cope with their condition (Hagger & Orbell, 2003).

The perception of psoriasis as a chronic condition was associated with BMI which aligns with previous qualitative evidence (Pavlova et al., 2022; Suliman et al., 2021). Although perceiving psoriasis as a chronic condition is accurate (Parisi et al., 2013), such perception may negatively influence coping behaviours (Price et al., 2012; Hagger & Orbell, 2003). Based on previous evidence, perceiving psoriasis as chronic condition may exacerbate negative mood and increase tendencies to use emotional eating to cope with the psoriasis

associated burden (Beattie et al., 2015; Finan et al., 2015; Russell et al., 2016) which can ultimately interfere with weight loss behaviours (Henry et al., 2019).

Previous research also suggested that learning problem-focused strategies for responding to the source of stress or threat (e.g., beliefs that psoriasis is a chronic condition) may reduce emotional-focused coping behaviours (e.g., emotional eating) and ultimately lead to improved weight outcomes (Parker & Endler, 1992; Spoor et al., 2007). Self-care activities, including exercise, joining a psoriasis support group, and moving towards self-compassion rather than self-criticism are all examples of problem-focused coping methods that could replace emotional eating (Parker & Endler, 1992). Thus, supporting weight loss or preventing weight gain (Wang, Pbert, & Lemon, 2014).

Findings from the current study also indicated that self-reports of managing psoriasis and high body weight as two separate conditions was linked to having a higher BMI. Previous qualitative findings suggested that people living with psoriasis did not have a clear understanding of the link between psoriasis and body weight (Pavlova et al., 2022). In the current study, however, having a weaker understanding of the link between psoriasis and high body weight was not associated with BMI. It seems that self-management of psoriasis and body weight is more important. This observation provides a foundation for designing a targeted tailored weight loss programme in the context of living with psoriasis. Targeted tailored weight loss support may lead to more optimal patient outcomes since weight reduction is associated with reduced disease severity and increased treatment response in psoriasis (Budu-Aggrey et al., 2019; Snekvik et al., 2017).

In the wider literature, obesity management is often challenged by psychological difficulties such as depression and anxiety (Mazzeschi et al., 2012; Somerset et al., 2011). However, the current findings are consistent with previous evidence specific to psoriasis which has reported no association between depression or anxiety with body weight (Pavlova et al., 2021; Pavlova et al., 2022). The current findings align with previous literature (Pavlova et al., 2021; Pavlova et al., 2022) suggesting that a broader range of psychological factors such as illness perceptions and emotional eating may be more important factors affecting body weight in psoriasis.

Contrary to the expectations, physical activity did not moderate the association between emotional eating and BMI or waist circumference. A previous study reported an inverse correlation with how badly patients rated their own psoriasis and the amount of moderate or vigorous physical activity they participated in (Wilson, 2013). Thus, it seems like illness perceptions may play an important role in physical activity behaviours. These findings and the observations from this study that the perceptions of psoriasis as a chronic condition are associated with BMI require the consideration of illness perceptions as a moderator of the association between physical activity and weight-related outcomes.

Limitations of the current study and future directions

To the best of our knowledge, this is the first study to look at a broad range of cognitive, emotional, and behavioural factors, including illness perceptions and emotional eating, and their associations with weight-related outcomes in psoriasis. Strengths of this study include the measurement of variables used, including the use of two weight-related measures – waist circumference as a valid marker of abdominal and visceral fat (Ross et al., 2020), in addition to the more commonly used BMI which does not differentiate between body fat mass and

muscle mass (Luz et al., 2016). The study also used more robust, continuous measures of depression and anxiety when exploring their relationship to body weight in psoriasis, while adjusting for important demographic, lifestyle, and illness-related factors. The current data must be, however, interpreted with some caveats in mind. Using a single data point precludes us from establishing causality of the observed associations. Also, the current sample has minimal ethnic diversity, limiting the generalisability of findings. Recruiting the sample online may have also influenced the type of respondents we received who self-selected to take part. Most recruited participants were females (77.2%) and reported previous weight management intentions (95.2%) which might be indicative of a highly selective sample with limited generalisability. In addition, all outcomes were self-reported meaning we have not evaluated outcomes against objective clinical markers. For example, waist circumference data was recorded in a dichotomised manner due to the self-reported nature of this measurement. Thus, the dichotomised waist circumference might have limited the utilisation of waist circumference as more precise measure of body fat mass, in comparison to BMI, which may have obscured relationships with cognitions, emotions, and behaviours. It seems that differences in physical activity or tendencies to emotionally eat did not moderate the associations between emotional eating or depression with weight-related outcomes, respectively. These findings may be due to methodological flaws. Moderation analysis require large sample sizes which might have led to reduced power in the current study, despite that the target sample size was achieved in the current study. Self-reported measure of physical activity might have also obscured the findings which urges future studies to use triangulation approaches to measuring both physical activity and emotional eating to confirm the observations from the current study (Perlesz & Lindsay, 2003). Future research could therefore utilise objective clinical outcomes to assess relationships between these factors and weight in psoriasis.

Conclusion

Emotional eating was linked to both high BMI and waist circumference. Emotional eating may be perceived as helpful to mitigate the negative psoriasis-induced mood in the short-term. However, it is likely to lead to weight gain and negative mood in the long-term. Illness perceptions, as indicated in other studies, may be unhelpfully influencing coping behaviours and driving emotional eating. Beliefs about psoriasis chronicity and self-reports of managing psoriasis and high body weight as two separate conditions were both linked to high BMI.

This may have contributed to the observed link between emotional eating and high BMI and waist circumference; findings which need to be confirmed in future studies. Clinicians can aim to (1) encourage the integrated self-management of psoriasis and obesity by emphasising on the link between both conditions and (2) try and facilitate helpful coping strategies to deal with the psychological burden of living with psoriasis. The current study findings suggest that there are psychological factors, including illness perceptions and emotional eating, that could be targeted in a tailored illness-specific weight loss intervention that addresses the unique challenges of weight management while living with psoriasis.

We would like to thank people who took part in this study and the recruitment support provided by The Psoriasis Association and The Psoriasis and Psoriatic Arthritis Alliance.

END OF ARTICLE SUBMITTED FOR CONSIDERATION FOR PUBLICATION

8.3. Concluding remarks

The findings from the current study identified the cognitive and behavioural factors that may have implication to obesity management in psoriasis. Illness perceptions related to psoriasis chronicity and the perceived separate self-management of psoriasis and obesity were both linked to high BMI. Emotional eating, from another hand, was linked to both BMI and waist circumference, possibly as a result of the psoriasis associated negative beliefs and the need to cope with them. It is likely that negative illness perceptions drive unhelpful coping behaviours such as emotional eating, findings that require further investigation in future studies. In addition, depression and anxiety were not associated with weight related outcomes despite the improved investigational methodologies as compared to previous studies, findings that align with the cross-sectional and longitudinal analysis, presented in Chapter six.

Surprisingly, physical activity was not associated with BMI or waist circumference in the presented cross-sectional study, despite that the qualitative interviews (Chapter seven) highlighted that people living with psoriasis consider physical activity, rather than dietary modifications, as the primary strategy to weight reduction. These findings have important clinical implications that are discussed in the next chapter. In addition, the next chapter will focus on discussing the overarching aim of this thesis with a focus on the conducted studies. The theoretical and clinical implications from the presented research will be also acknowledged.

Chapter 9: Discussion

9.1. Chapter overview

The aim of this thesis was to identify the cognitive, emotional, and behavioural factors that are associated with body weight in psoriasis that can, in later research, guide the development of a multifaceted weight loss intervention for people with psoriasis and obesity. This thesis presented a series of empirical studies beginning with a systematic review, cross-sectional and longitudinal study, and qualitative study, which collectively informed the cognitive, emotional, and behavioural factors that are potentially associated with body weight. The associations of these factors with body weight were included in the last cross-sectional study of this thesis which was presented in the previous chapter.

In this concluding chapter, a summary of the overall findings of this thesis is presented. The discussion focuses on the novel contribution of these findings to the understanding of obesity management in psoriasis and their contribution to the existing literature. This is followed by a discussion on the theoretical and clinical implications in the context of the broader weight loss management in chronic illnesses literature. The limitations of the empirical investigations included in this thesis are then listed, along with recommendations for how to overcome them in future research. Lastly, future directions are taken into consideration in light of the conclusions of this thesis.

9.2. Summary of the main findings & contributions to existing literature

The studies in this thesis offer novel insights into obesity management in psoriasis and addressed an important research gap in this area of evidence. This was the first body of evidence to explore potentially modifiable psychosocial factors related to body weight in psoriasis using a mixed-methods approach and a theoretical framework to guide the design of

the studies. Such an approach was particularly important because psychosocial factors have been generally overlooked in weight loss interventions in psoriasis which may be explaining the limited effectiveness on outcomes. The studies in this thesis offer novel insights into the experiences of people living with psoriasis and obesity and provide preliminary evidence for the potential implementation of psychosocial factors into psoriasis weight loss management intervention. Tailoring an illness-specific weight loss intervention to address the unique challenges of weight loss while living with psoriasis may be more effective in the long-term (Clark et al., 2004; Peckmezian & Hay, 2017a) and have been supported by the National Institute for Health and Care Excellence (NICE, 2012). Therefore, the work of this thesis makes novel, distinctive, and important contributions to the literature with substantial clinical implications.

Given the high prevalence of depression in psoriasis and the strong association between high body weight and depression in the general literature, it was crucial to understand the potential association between psychosocial challenges such as depression with obesity in psoriasis. Prior to this thesis, weight loss interventions in psoriasis were primarily based on general behavioural change weight loss models that focused on dietary improvements and physical activity with no considerations of the psychological challenges that people living with psoriasis need to deal with daily, as discussed in Chapter one. Comorbid obesity may add additional burden on patients' lives and compromise both physical and psychological outcomes, as discussed in Chapter two. These observations urged the need to synthesise existing evidence on the psychosocial factors that may be associated with body weight in psoriasis and ultimately can be targeted as part of illness-specific weight loss intervention for people living with psoriasis. The systematic review in Chapter three (Pavlova et al., 2021), which synthesised and evaluated the available evidence on the psychosocial factors that are

associated with obesity in psoriasis, guided the direction of the research studies within this thesis and made an important contribution to the literature. The systematic review was valuable because it showed that most studies that acknowledged the role of psychosocial factors to date focused on the associations between depression or anxiety with high body weight in psoriasis (Cohen et al., 2016; Innamorati et al., 2016; Kim et al., 2014; Lewinson et al., 2017; Tabolli et al., 2012). The observed associations between depression or anxiety with body weight were weak or null rather than strong as observed in the general obesity literature (De Wit et al., 2010; Luppino et al., 2010); discrepancies that may be due to methodological flaws.

The identified methodological limitations of the research included in the systematic review were used to guide the design of the next cross-sectional and longitudinal study, presented in Chapter six. The addressed methodological issues that may have impacted the association between mental health and body weight in psoriasis included: (i) the cross-sectional nature of the evidence included in the review which precluded determining the direction of causality of the examined association, (ii) the failure to control for possible confounding factors such as demographic and illness-related factors, and (iii) the use of BMI as an indicator of excess body weight, while it may not completely reflect trends in body fat.

To address the methodological limitations of the systematic review, Chapter six included a cross-sectional and longitudinal study which drew on routine care data to gain a better understanding of the role of depression and anxiety in psoriasis weight-related outcomes. This study added to the small number of studies in this area by examining the association between mental health and body weight using waist circumference as a valid marker of abdominal and visceral fat (Ross et al., 2020), in addition to the commonly used BMI

(Pavlova et al., 2021). The study improved on prior cross-sectional evidence by adjusting the analysis for several important demographic and illness-related factors that could confound the links between mental health and weight-related outcomes. In addition, this was the first study to examine these relationships over time. This study revealed a lack of association between depression or anxiety with waist circumference and BMI cross-sectionally or 12 months later, when adjusting for demographic and illness-related factors. These findings disagreed with some of the previous studies in psoriasis (Innamorati et al., 2016; Kim et al., 2014) and in the general literature (Luppino et al., 2010) and should be interpreted with some caveats in mind.

Previous studies did not adjust for important confounders such as psoriasis severity and medical comorbidities (Innamorati et al., 2016; Bronckers et al., 2018; Pavlova et al., 2021) which might have obscured the reported positive associations. The different findings may be also because this study used a cut-off to define probable caseness of depression and anxiety (Kroenke et al., 2001; Spitzer et al., 2006). Continuous measures were adopted in other research that indicated a link between depression and weight outcomes (Cohen et al., 2009). It may be that distress, rather than clinically defined categories of anxiety and depression, is associated with weight outcomes (Kroenke et al., 2007; Kroenke et al., 2001). Although this study addressed the limitations identified in previous research, depression and anxiety and their relation to high body weight were examined in isolation, which made it difficult to ascertain how a range of different factors interact to perpetuate high body weight in psoriasis. This contrasts with the broader obesity literature that refers to a range of modifiable cognitive and behavioural factors that may be better explaining the high body weight, yet remain understudied in psoriasis. These include body image issues, low motivation, impaired self-confidence, and perception of self (Burgess et al., 2017; Greaves et al., 2017; Grossi et al., 2006; Jung & Luck-Sikorski, 2019; Moroshko et al., 2011; Ohsiek & Williams, 2011) that

may hinder positive weight loss outcomes, contributing to obesity. Associated illness perceptions and beliefs have been also linked to body weight and overall success of committing to weight loss related behaviours (Cohen et al., 2016; Dalle Grave, Sartirana, et al., 2020). These findings warrant qualitative explorations that were presented in Chapter eight of this thesis.

The use of mixed-methods approaches in health psychology, as argued in Chapter five, enables researchers to fully utilise both qualitative and quantitative methods and to combine their findings into a final product that is more than the sum of their individual parts (Yardley & Bishop, 2017). Therefore, the key advantage of this research work was the use of mixed methods approach towards achieving its main goals and objectives. The qualitative and cross-sectional research constituents within this thesis offered a novel perspective into obesity management in psoriasis. Their integrated use allowed to produce a research output that is superior to their individual findings in isolation. The qualitative study in Chapter eight (Pavlova et al., 2022) was the first study to qualitatively explore obesity associated beliefs, perceptions, and behaviours among adults with psoriasis. This study provided an in-depth understanding of the obesity associated beliefs, perceptions, and behaviours and highlighted the importance of key intervention targets through the conduction of open-ended interview approach with inductive thematic analysis. As outlined below, the qualitative study highlighted important factors that have both clinical and research implications.

Adults living with psoriasis reported different illness perceptions and behaviours that impacted their abilities to engage in obesity management practices. Adults living with psoriasis and obesity perceived both conditions as unrelated, indicating lack of illness coherence that may potentially compromise weight loss associated behaviours and subsequently weight loss

outcomes, as outlined in previous research (Leventhal et al., 2011). This theme highlighted the importance for clinicians to discuss the link between obesity and psoriasis (Mahil et al., 2019) and how it may potentially relates to improved disease severity and improved treatment response (Budu-Aggrey et al., 2019). It also urges future research to explore if the lack of illness coherence is associated with weight-related outcomes; objectives that are investigated in the following cross-sectional study of this thesis. Such an approach may provide an opportunity for more optimal management of high body weight in psoriasis.

Adults living with psoriasis also believed that general weight loss recommendations focused primarily on dietary and physical activity changes, failing to acknowledge the perceived psoriasis burden, which may compromise weight loss related outcomes. Illness perceptions may help to uncover the specific beliefs that patients hold towards their illness and ultimately their relevance to high body weight. Driven by this assumption, the next study within this thesis, discussed below, focused on the association between illness perceptions and weight loss related outcomes. Such findings may support the selection of cognitive strategies to be included as part of tailored illness specific weight loss interventions for adults living with psoriasis and obesity.

In terms of the reported behaviours that may interfere with obesity management, emotional eating in response to the psoriasis burden and associated negative emotions was seen as the leading one. Similarly to previous findings (Auker et al., 2020; O'Loughlin & Newton-John, 2019), people living with psoriasis perceived food as a comforting strategy in the face of the psoriasis burden and associated negative emotions. As discussed in Chapter four, emotional eating is a theoretically grounded constructs and it is known to be used as a coping mechanism when people experience negative affect and are not motivated or unable to apply more

constructive ways of coping with the threat (Spoor et al., 2007). Comfort eating is a potentially modifiable behaviour that can be targeted in interventions aiming to improve eating behaviours and associated weight loss outcomes (O'Reilly, Cook, Spruijt-Metz, & Black, 2014). Before proposing emotional eating as an important construct for implementation within tailored weight loss interventional approaches for people living with psoriasis, it was considered as crucial to investigate its association with high body weight; objectives that were also targeted in the next cross-sectional study of this thesis.

Considering the findings discussed above, a strength of the qualitative study was its open-ended inductive approach which facilitated the identification of the described themes. The semi-structured open-ended nature of the interview schedule was designed to prompt responses in regards to participants' weight loss associated cognitions and behaviours. Such an approach allowed the uncovering of novel insights that were not constrained to the research questions. For instance, while designing the interview schedule, the researcher had not considered the criticality of emotional eating in the management of psoriasis to potentially optimise weight loss outcomes. Once identified in early interviews, the requirement of including emotional eating support as part of tailored intervention approaches was subsequently explored in the following interviews which highlighted the need to include a measure of emotional eating to the cross-sectional study. One of the main advantages of the qualitative part of this research was the opportunity to consider aspects that were not bound by the researcher's preconceived ideas. In addition to the novel insights that were highlighted, the qualitative study also made an important contribution that guided the design of the next study.

The cross-sectional study built up on the findings of the qualitative study by investigating the role of illness perceptions and behavioural factors such as emotional eating in relation to high

body weight. A strength of the cross-sectional study was that it investigated the broader weight loss associated cognitive and behavioural factors, beyond the emotional factors (e.g., depression and anxiety), that were the primary focus of previous research, as identified in the findings of the systematic review, discussed in Chapter three (Pavlova et al., 2021). The findings from the cross-sectional study further emphasised on the need for clinicians to inform patients about the link between psoriasis and high body weight, given that self-managing of psoriasis and high body weight as two separate conditions was positively associated with high BMI which aligns with the qualitative findings that highlighted the lack of coherent illness understanding (Pavlova et al., 2022).

Another important finding that emerged from the cross-sectional study were that the perception of psoriasis as a chronic condition was associated with BMI. Although perceiving psoriasis as a chronic condition is accurate (Parisi et al., 2013), such perception may negatively influence coping behaviours (Price et al., 2012; Hagger & Orbell, 2003). Based on previous evidence, perceiving psoriasis as chronic condition may exacerbate negative mood and increase tendencies to use emotional eating to cope with the psoriasis associated burden (Beattie et al., 2015; Finan et al., 2015; Russell et al., 2016). In fact, emotional eating in the current study was associated with both BMI and waist circumference. Food is often used as emotion regulation and stress coping strategy in the general population (Loeber et al., 2018; Spoor et al., 2007). Previous literature has suggested that people living with high body weight and psoriasis may use food high in fat and sugar to cope with psoriasis-induced negative emotions (Leventhal et al., 1997; Leventhal et al., 1998; Spoor et al., 2007). Emotional eating may improve psoriasis-associated negative mood in the short-term, however, the perceived benefits may diminish shortly after, and ultimately lead to increased negative affect (e.g., sadness and guilt) (Haedt-Matt & Keel, 2011) and the risk of increased body weight (Konttinen, Silventoinen, et al.,

2010; Konttinen et al., 2019; O'Loughlin & Newton-John, 2019). These findings highlight the need to consider the role of illness perceptions and emotional eating in tailored weight loss interventions for people with psoriasis.

Considering the findings discussed above, another strength of this research programme was the explorations and investigations of the psychosocial factors in the context of both obesity and psoriasis. Despite the well-established link between obesity in psoriasis (Mahil et al., 2019), previous research focused on separate investigations of either psoriasis or obesity and their associations with potentially modifiable psychosocial factors. The limited studies that focused on investigating the psychosocial factors that may be relevant to obesity in the context of psoriasis did not yield sufficient details to inform a tailored illness specific intervention. These observations are further supported by the fact that all weight loss interventions in psoriasis seem to be generic, focusing on physical activity and dietary modifications, with no emphasis on the idiosyncratic challenges of living with psoriasis. The empirical studies in this thesis addressed this gap in the literature by qualitatively and quantitatively investigating the broader cognitive, emotional and behavioural factors that may be relevant to the context of obesity in psoriasis. Despite the well-established link between depression or anxiety with high body weight in the general population (De Wit et al., 2010; Luppino et al., 2010), there was a good agreement between the studies within this thesis (Pavlova et al., 2022; Pavlova et al., in submission) regarding the lack of association between depression or anxiety with high body weight. Such discrepancies urge future research to assess mood in the context of psoriasis and obesity, keeping in mind that it may not be the actual affect that interferes with optimal weight outcomes but rather how people perceive and cope with the negative affect.

Collectively, the integration of findings from the systematic review, the cross-sectional study using routine patient data, the qualitative study, and the cross-sectional study that aimed to quantitatively explore the findings from the qualitative study provided understanding of the factors that may be included and tested as part of tailored illness specific intervention for people living with psoriasis. It should be noted, however, that these factors were informed by a systematic review and exploratory cross-sectional and qualitative research which highlight the potentially tentative nature of the findings urging future studies to evaluate the current conclusions in a more robustly designed study. Despite being aware of these limitations, it is important to keep in mind that the identification of relevant cognitive, emotional, and behavioural factors was not exclusively based on the actual results of the studies included in this thesis. The broader obesity literature, as discussed in Chapter two, and the most recent psoriasis management recommendations emphasise on the need to consider obesity problem in psoriasis as a complex multifactorial issue that requires the acknowledgement of people's emotional well-being in any treatment regimen (NICE, 2012). The integration of cognitive, emotional, and behavioural factors that contribute to obesity in psoriasis makes an important contribution to the literature. It also provides a theoretical framework that may be used to further explore these factors to achieve a more in-depth understanding of obesity in psoriasis.

9.3. Theoretical implications

This thesis has theoretical implications. Its research questions were based on theory, and its findings have important implications for the complex conceptualisation of obesity in psoriasis. Prior to this thesis, most studies in the area of obesity in psoriasis explored related factors (e.g., depression and anxiety) in isolation, without recognising how different factors may interact with each other to perpetuate obesity in psoriasis or vice versa. Obesity in psoriasis is multifactorial issue that is influenced genetics, epigenetic, behavioural,

psychological, and environmental factors (Albuquerque et al., 2017). Since genetic factors are non-modifiable, it is important to focus on other modifiable factors such as behavioural and psychological (Skender et al., 1996; Spiegelman & Flier, 2001). This thesis aimed to identify the cognitive, emotional, and behavioural factors that are relevant to obesity in psoriasis, considering the evidence from the general obesity literature and other patient populations. As described within the previous chapters, the findings of the studies in this thesis contradicted the findings from the general literature that obesity is associated with depression and anxiety (Luppino et al., 2010). These findings set up the assumptions that it is not the actual effect of depression and anxiety that may be important in relation to body weight but rather how people manage or cope with their mood. Consistent with the findings from other patient populations, people living with psoriasis and obesity were likely to hold negative perceptions towards their illness and to engage in avoidant coping strategies such as emotional eating. The integration of these findings suggests that adopting a cognitive behavioural theoretical approach to obesity is appropriate in psoriasis, and that it would be beneficial for future research to explore obesity in psoriasis within this context.

Based on the findings from the empirical studies within this thesis, as well as evidence from the broader obesity literature and in other patient populations, a summary of the cognitive, emotional, and behavioural factors in relation to obesity in psoriasis was provided. This summary was based on the idea that cognitions, emotions, and behaviours interact between each other and can influence body weight outcomes. Common Sense Model of Self-Regulation (CSM-SR) as well as theories of emotional eating (Chapter four dedicated to these theories) were also considered when outlining relevant factors of interest. Negative illness beliefs that psoriasis is a chronic uncontrollable illness with serious consequences (Study 3), alongside negative interpretation and lack of integrated self-management of

obesity and psoriasis (Study 4) may lead to increased negative affect such as frustration and embarrassment that are already present in psoriasis, as discussed in Chapter one and two. This, in turn, may trigger unhelpful coping behaviours such as emotional eating (Study 3 and 4). These processes may also contribute to weight gain and/or inability to lose weight. The Affect Regulation theory and Escape theory support this potential direction of negative affect triggering unhelpful coping behaviours such as emotional eating. Despite that how people experience and cope with the negative affect is likely to be influenced by broader social and contextual factors, such as having an illness. As mentioned earlier in this chapter, to integrate the context of psoriasis, CSM-SR was considered as a relevant framework for the theoretical underpinnings of this thesis (Leventhal et al., 1997).

While the theories of emotional eating, the Affect Regulation theory and Escape theory, assume that illness representations influence health outcomes (e.g., weight-related) through the mediation of coping, the CSM-SR did not support this idea. Rather, the CSM-SR suggests that illness representations are significantly associated directly with health outcomes above and beyond the biological progression of the illness (Brooke & Lusher, 2012; Hagger & Orbell, 2003). In line with that and the findings from the general literature, different coping methods such as problem- and emotional-focused and avoidance has been associated with illness perceptions. For example, problem-focused coping has been positively associated with personal and treatment control, and negatively associated with emotional representations. Avoidant coping has been positively associated with identify and emotional representations and negatively associated with coherence. However, a longitudinal study demonstrated the importance of the association between illness perceptions and coping strategies over time. Illness representations expressed prior to treatment were significantly positively associated with coping strategies at six to eight months but not at one month post treatment (Llewellyn,

McGurk, & Weinman, 2007). Together these findings demonstrate the need to consider the longitudinal associations between illness representations and coping strategies in psoriasis and how these may influence weight-related outcomes.

In addition, the lack of association between coping strategies and health outcomes, as implied by the CSM-SR, contradicts the findings from the last cross-section study (Study 4) in this thesis that emotional eating is positively associated with weight-related outcomes. As discussed in Chapter eight (Study 4), it could be that negative illness perceptions such as seeing psoriasis as a chronic condition influence coping behaviours (emotional eating) which then drive high body weight. These findings align with the assumptions of the theories of emotional eating that negative affect drive unhelpful coping behaviours which, in turn, influence health outcomes; findings that require future investigations.

9.4. Potential clinical implications

This thesis has made an important contribution to the literature, addressing some important gaps in the current understanding of obesity in psoriasis. The findings from the empirical studies within this thesis have some important clinical implications. Obesity is a common comorbidity of psoriasis that is unlikely to be influenced by the conventional psychosocial factors, including depression and anxiety. Other factors such as illness perceptions and emotional eating emerged as potentially more important factors to obesity that can be targeted in a tailored illness specific weight loss intervention for people living with psoriasis, based on the qualitative and quantitative investigations within this thesis. The qualitative findings within this thesis also confirmed that people living with psoriasis and comorbid obesity prefer a weight loss treatment approach that focus on the physical and psychological burden of psoriasis; findings that align with the psoriasis management recommendations in

the UK (NICE, 2014) which stipulate the importance of prioritising the patient's psychological well-being in any treatment regimen. As discussed in Chapter two, weight loss approaches in psoriasis are rather reductionist and do not consider the complex nature of obesity in psoriasis that is likely influenced by relevant psychological and behavioural factors such as illness representations and emotional eating, as identified within this thesis.

Beyond the range of illness perceptions that were investigated in relation to body weight in psoriasis, lack of coherent knowledge of the link between psoriasis and obesity emerged from the qualitative study (Study 3), despite the well-researched and confirmed link between both conditions (Budu-Aggrey et al., 2019). With reference to the Common-Sense Model of Self-Regulation, the lack of understanding of participants' health may compromise the selection of self-management activities and treatment-seeking behaviours such as weight loss programs (Leventhal et al., 2011). Poor illness coherence has been also associated with higher levels of depression and poorer mental quality of life in other patient populations (Riera-Sampol et al., 2021).

To address this poor illness coherence, it would be important for people living with psoriasis to increase their knowledge in relation to the link between both psoriasis and obesity to improve health care outcomes. However, it is important to note that knowledge sharing should not be seen as a unidirectional activity where the clinicians 'transfer' knowledge to the patient due to the different lived experiences of each patient that should be taken into account (de Jongh, Redding, & Leonard, 2019). An increased focus on self-management is based on the patient-professional trust which requires multi-direction knowledge sharing (Bodenheimer, Lorig, Holman, & Grumbach, 2002). The first step of this process would require clinicians to address the knowledge patients hold in relation to their psoriasis and

comorbid obesity. Then, patients should be given the opportunity to discuss their lived experiences with psoriasis and obesity. This would be an opportunity for clinicians to identify if referral to weight loss or psychological support may be best suited for the individual patient. For example, if the patient presents with strongly held negative beliefs and perception towards psoriasis, a psychological support may be most appropriate for them. In comparison to a patient who presents with a lack of knowledge in regards to physical activity and healthy eating who may benefit more from a behavioural weight loss support. Such multidisciplinary approach to weight loss management has been shown as promising in people with long term conditions in terms of improving not only weight-related outcomes but also overall well-being (Svetkey et al., 2008).

Illness perceptions also have potential implications to physical activity behaviours. A previous study reported an inverse correlation with how badly patients rated their own psoriasis and the amount of moderate or vigorous physical activity they participated in (Wilson, 2013). Thus, it seems like illness perceptions may play an important role in physical activity behaviours. These findings and the observations from the cross-sectional study (Study 4) that the perceptions of psoriasis as a chronic condition are associated with BMI require the consideration of illness perceptions as a moderator of the association between physical activity and weight-related outcomes. Physical activity is often considered as an obesity management strategy within both the general and psoriasis literature (Naldi et al., 2014; Swift et al., 2018). High levels of PA are inversely associated with cardiovascular disease, Type 2 Diabetes Mellitus (T2DM) and all-cause mortality. The present American College of Sports Medicine (ACSM) recommendations for physical activity to promote *clinically significant weight loss* are 225 mins to 420 mins of physical activity per week (Donnelly et al., 2009). These recommendations may be unachievable and even unrealistic

for people living with psoriasis who fail to reach a minimal physical activity levels and often experience physical (e.g., skin itchiness) and psychological challenges (e.g., embarrassment) when planning or engaging in physical activities, as demonstrated by previous research and the qualitative findings of this thesis (Auker et al., 2020; Pavlova et al., 2022). Thus, it would be important for clinicians to explore perceived barriers to weight loss and to address them before making any specific physical activity recommendations. These postulations are also in alignment with the need to implement a multidisciplinary approach to obesity management in psoriasis. An example of such an initiative is the Integrating Mental and Physical Healthcare: Research Training and Services (IMPARTS) screening program that was introduced in Chapter six, as part of Study 2.

Within the cross-sectional and longitudinal analysis, routine patient data were used collected through IMPARTS screening program. The IMPARTS programme provides a multifaceted platform of clinical and research services to assist in the integration of mental healthcare into routine care for patients with physical health conditions and is currently used in psoriasis (Rayner et al., 2014). IMPARTS aims to facilitate integrated care by providing clinical teams with the skills to identify, manage and monitor mental health disorders and their impact on physical health and functioning, mainly through questionnaire assessments (Rayner et al., 2014). In dermatology conditions, including psoriasis, screening for mental health conditions has had a very high uptake (98%). The proportion of people living with psoriasis declining to complete the IMPARTS questionnaires was also low (0.6%). Together these findings indicate the high feasibility and accessibility of integrating mental health support in psoriasis.

Findings from the qualitative study within this thesis also emphasised on the fact that people living with psoriasis prefer to have a tailored weight loss advice that goes beyond exclusively

behavioural approaches and focus on their emotional well-being (Pavlova et al., 2022).

Standard behavioural weight loss strategies, discussed in Chapter two, could be enhanced by the inclusion of cognitive techniques that address common psychological difficulties such as psoriasis-related stress and negative body image. Such an approach is likely to reduce weight loss intervention attrition to support long-term maintenance of behaviours for sustained weight loss (Dalle Grave et al., 2014; Dalle Grave, Sartirana, et al., 2020); findings that require future investigations in psoriasis.

Another important clinical implication that emerged from the studies within this thesis is the need to focus on reducing emotional eating. This is an essential clinical implication that may support obesity management in psoriasis, given that people perceived food as a way to cope with the psoriasis associated burden (as outlined in the qualitative study in Chapter seven) and that emotional eating is associated with BMI, as indicated in the cross-sectional study, presented in Chapter eight. Therefore, teaching people living with psoriasis more helpful coping strategies for responding to the negative illness perceptions may reduce emotional eating and ultimately lead to improved weight outcomes (Parker & Endler, 1992; Spoor et al., 2007). These strategies may include self-care activities such as joining a psoriasis support group, and moving towards self-compassion rather than self-criticism with the aim to replace emotional eating (Parker & Endler, 1992). Thus, supporting weight loss or preventing weight gain (Wang et al., 2014).

Collectively, these findings indicate the need to approach obesity management in psoriasis from a multidisciplinary perspective that should include emphasis on illness perceptions and coping behaviours, ideally overtime. The perspective of people living with psoriasis should be acknowledged as part of any clinical decisions and recommendations. Although a number

of potential clinical implications may be drawn, issues with methodological flaws of the conducted research should be addressed and considered in future research.

9.5. Limitations of the conducted studies

The empirical studies presented within this thesis have several limitations that have been discussed in the relevant chapters. These limitations are further discussed below in more detail, concluding with a summary of the overall limitations of this thesis.

9.5.1. Systematic review

In anticipation of the limited number of studies that investigated the psychosocial factors of obesity in psoriasis, intentionally broad inclusion criteria were used, particularly with regards to body weight and psychosocial factors. This resulted in the identification of a heterogeneous selection of studies. Most of the studies included in the systematic review were not aimed specifically at obesity or body weight, and were deemed of poor methodological quality. Therefore, as stated in Chapter three, the findings from the systematic review need to be interpreted with caution and the subsequent studies included within this thesis aimed to address its limitations. Nonetheless, this systematic review made a valuable contribution by confirming the lack of theory and evidence-based studies that examined the role of psychosocial factors in the context of obesity and psoriasis as well as the predominant use of BMI as the main outcome in the included studies; findings that supported the conceptualisation of the next cross-sectional and longitudinal study.

9.5.2. Cross-sectional and longitudinal study

As briefly mentioned in Chapter six, attrition bias likely affects the longitudinal findings from this study. High attrition rates are particularly common in studies that focus on psychological

factors among people with psoriasis (Qureshi, Awosika, Baruffi, Rengifo-Pardo, & Ehrlich, 2019). To account for the potential attrition, the study analysis included a comparison of the samples with available weight-related data to those with missing weight-related data at 12 months follow-up on variety of demographic, illness severity, and mental health measures. The findings indicated that patients with missing waist circumference and BMI data at follow-up, were significantly less likely to be on systemic treatment for psoriasis compared to those not missing weight-related outcome data. These findings may be due to the high psoriasis management burden and multi-morbidities experienced by patients who manage their psoriasis with topical treatment that are highly burdensome and demanding (Griffiths et al., 2018). To account for this observation, the studies within this thesis adjusted the analysis for treatment type.

Additionally, the cross-sectional design of the study is limited as it restricts the conclusions that can be drawn from the findings. Although it provided useful insights into factors that may be related to obesity in psoriasis, the direction of causality cannot be inferred from the findings. It is possible that people living with obesity and psoriasis report more negative experiences with the skin condition simply because their experiences are more burdensome. Even if this is the case, it may still be useful to address cognitive, emotional, and behavioural factors in the context of obesity, given that weight loss interventions targeting these factors in the general obesity literature have been promising and may provide a more tailored approach in the context of psoriasis.

9.5.3. Qualitative study

Several limitations relating to the qualitative study have been discussed in Chapter seven and some are further elaborated here. An important limitation is the single data-collection period, as it is less likely to capture daily mood and experiences, not necessarily generalisable to the

overall experiences of the sample. Additionally, participants were recruited online and were not screened for mental health status (e.g., depression or anxiety) for inclusion in the study to gather insights on differences in experiences between people with compromised mental health and those with optimal mental health. Recognising the fact that there may be individual differences based on people's mental health status may have provided additional insights of people's weight loss related perceptions and experiences.

It is also important to note that qualitative analysis relies on the coder's understanding and interpretation of the data, and multiple ways of interpreting the data are possible. To minimise potential biases due to subjectivity in data collection and interpretation, a semi-structured interview schedule was designed, providing participants with the flexibility to discuss aspects of obesity and psoriasis important to them and not being limited by pre-formulated assumptions. The interviews were also conducted by two different researchers (NP and CR) further supporting the aim to limit subjectivity within the research design.

Furthermore, to reduce bias within the data analysis, data was coded and themes were formulated by two researchers (NP and CR). Codes were independently coded by the two authors using the initially designed coding manual. Before updating the coding manual, the coding was compared, and similarities and differences were examined. The first and second author used the final coding manual to apply to the entire data set, labelling data extracts with relevant codes and noting any probable patterns between items that could drive subsequent theme creation. Themes were regularly checked against the data and were discussed with the entire supervisory team aiming to reduce subjectivity and increase diversity in available perspectives in interpreting the data. Nevertheless, the involvement of public and patient involvement group in interpretation of the findings would have been valuable to further improve the accuracy of the coding manual and formulated themes.

9.5.4. Cross-sectional study

Consistent with the limitations of the previous cross-sectional analysis, discussed in Chapter six and also above (sub-section 9.5.2.), this cross-sectional study was limited by its small sample size and did not allow the comparison of participants based on their BMI. It is also possible that there were too few participants for the number of variables assessed, despite that the study reached its target sample size. However, the study findings still allowed for the identification of potentially relevant cognitive and behavioural factors that can be addressed in future studies focused on obesity in psoriasis in order to produce more high-quality research. Further limitations of this study are discussed in the relevant section of Chapter eight.

9.5.5. Overall limitations

The following section summarises some shared limitations between the different empirical studies within this thesis. The included studies were limited by the exclusion of non-English speakers, which limits the generalisability of the findings to people with psoriasis and obesity from different cultural backgrounds. Conducting research that is applicable cross-culturally is essential to be able to develop and offer support, recognising the unique experiences and challenges faced by minority ethnic groups. However, use of translators was not feasible within the timeframe and resource constraints of the PhD. The samples of the included empirical studies had a low number of people identifying themselves as not being from white ethnic background (cross-sectional and longitudinal study at baseline 19%; qualitative study 8%; cross-sectional study 13%). Due to the low frequency of some ethnicities, a crude categorisation into white versus non-white was used in the analyses.

In the longitudinal study, the substantial amount of missing data, although a typical characteristic of routine data, may have reduced the statistical power and ability to detect any differences. Moreover, those who decided to complete the available questionnaires and were subsequently included in the analysis might have potentially been systematically different than those who were excluded from the conducted analysis. It is likely that people who experienced highest level of depression and anxiety did not volunteer to complete the requested surveys. Non-response bias in research, especially in relation to obesity and/or psychological health, is unavoidable (Korkeila et al., 2001).

Finally, another major limitation across all the studies presented in this thesis, and more generally of this research area, is the use of self-report measures to psychosocial factors and weight-related outcomes. Self-reported measures are required to record complex and subjective phenomena; nonetheless, they may be prone to recollection and response bias, which are flaws brought on by pressure to provide socially acceptable responses or to appease the researcher (Gravetter & Forzano, 2018).

Self-report measures are necessary to capture complex and subjective constructs; however, they may be subject to recall bias, referring to inaccuracies in recall; and response bias, referring to inaccuracies due to pressure to give socially acceptable answers or to please the researcher (Gravetter & Forzano, 2018; Paulhus & Vazire, 2007). Additionally, responses may be significantly influenced by the setting at the time of questionnaire completion or more recent levels of the measure, known as the recency effect, which may not represent accurately the actual levels of the measure (Paulhus & Vazire, 2007). For example, participants may report higher levels of emotional eating when completing the questionnaire on eating behaviours when coping with stress.

The self-report measures used in the empirical studies of this thesis were selected carefully based on evidence for their psychometric quality, as addressed in Chapter five. Selected questionnaires to assess the target psychological variables were all with good psychometric qualities. Yet it would be valuable to assess the understanding of people living with psoriasis and obesity in relation to the items of each scale via qualitative methodology to ensure that the scale is appropriate and captures the complexity of obesity in this setting. In relation to the self-reported clinical factors, these may have been evaluated more precisely by accessing patient records. However, this was not possible as the researcher did not have access to patient records within all NHS trusts, and did not have access to medical records of patients recruited online. Except for the cross-sectional and longitudinal analysis (Study 2) which has used routine patient data that provided clinician assessments of weight-related data, but self-reports of depression and anxiety.

9.6. Future research

This thesis made important novel contributions to the existing literature. Despite that, there is a lot to be learned about obesity in psoriasis. Future research is necessary to expand on the findings from this thesis, and to address the identified limitations, both within the existing literature as well as the ones from the studies conducted as part of this thesis.

The limited evidence that has focused on the psychosocial factors of obesity in psoriasis is constrained by the narrow focus on mainly depression and anxiety. Despite the conducted studies in this thesis aimed to expand on this evidence and build understanding of the broader cognitive and behavioural factors that may be important in relation to body weight in psoriasis, future studies should be conducted with larger sample sizes to further improve the understanding of the complexity of obesity in psoriasis. The research findings from the

conducted research in this thesis is limited to a single country and may not adequately represent people living with psoriasis from other backgrounds. International collaborations are required to provide more comprehensive understanding of obesity in psoriasis and associated psychosocial factors.

In addition to the need to replicate the current findings in studies with larger sample populations with different ethnic backgrounds, future research should aim to conduct longitudinal research to establish whether the psychosocial factors of obesity differ across the disease course. As psychological state naturally fluctuates across time, it is likely that participants' responses to psychological questionnaires in cross-sectional research are influenced by their mood at the time of questionnaire completion. It would be important to investigate the relationship between psychosocial factors and obesity across different psoriasis symptoms. This will provide the opportunity to assess more clearly whether cognitions and behaviours related to body weight differ based on clinical indicators such as psoriasis severity, when psoriasis is in remission, or presents with active flare-ups. Therefore, longitudinal research may provide more accurate assessment of the psychosocial factors of obesity in psoriasis across time. Longitudinal methods should also be employed to assess whether the illness perceptions and emotional eating predict obesity in psoriasis over time.

Finally, future research should attempt to take a multidisciplinary approach to obesity management interventions in psoriasis to enhance its feasibility in clinical practice. Public and Patient involvement groups of people living with psoriasis and obesity should be consulted across all phases of the intervention development. Findings from the qualitative study (Chapter seven, Table 5) can be used as a basis to the structure for intervention development. Once the intervention has been refined, it would be important to further assess

its efficacy before implementation. RCT design that aim to alter illness representations and unhelpful coping behaviours such as emotional eating should be adequately powered and ideally conducted over time to assess changes in weight related outcomes in people living with psoriasis.

9.7. Conclusion

This thesis demonstrated that obesity management in psoriasis may be best understood from a cognitive behavioural perspective. The qualitative and quantitative components of this thesis supported the utility of conceptualising obesity within a cognitive behavioural perspective with a focus on psoriasis illness perceptions and coping behaviours.

Evidence from the general obesity literature and from other chronic conditions suggests that modifying unhelpful cognitive and behavioural responses to symptoms may have benefit to weight loss related outcomes. These assumptions need to be tested in a theory and evidence-based intervention to expand on the findings from the current thesis and potentially move towards a more multidisciplinary approach to obesity management in psoriasis. Future research should aim to focus on exploring the cognitive and behavioural factors to identify which of them may offer the most useful targets for obesity management in psoriasis.

Important illness-related and demographic differences should be also factored to allow for more tailored approaches to obesity management. This approach would align with The Medical Research Council (MRC) framework for designing complex interventions which suggests that factors included in an intervention design should be both theory and evidence driven (Skivington et al., 2021).

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Appendices

Appendix A – Psychosocial aspects of obesity in adults with psoriasis: a systematic review related content

Table S1. The relation of psychosocial factors to weight-related outcomes by psoriasis severity

Psoriasis severity	Psoriasis severity	Psychosocial factor	Psychosocial assessment tool	Type of analysis	Cohen’s d [95% CI]	Correlation r [95% CI] or β if only multivariate regression reported	Magnitude of association ¹¹	p-value
Not reported								
Cohen et al., 2015, US	NR	Depression	PHQ-9	BMI of < 25 vs. BMI of >30	0.84 [1.04-2.20]		large	0.02*
				BMI of < 25 vs. BMI of >35	0.79 [0.98-2.08]		large	0.06
		Daily functioning impairment	A single question item answered on a Likert scale	BMI of < 25 vs. BMI of >30	0.70 [0.97-1.65]		medium	0.12
				BMI of < 25 vs. BMI of >35	0.75 [1.04-1.77]		medium	0.04*
Mild psoriasis								

¹¹ Insufficient available data (mean and SD) precluded the calculation of the magnitude of reported associations for some studies, which limits conclusions about the clinical significance of the findings.

Innamorati et al., 2016, Italy	Mild	Mental HRQoL	SF-12 health survey	Compared to obese people without psoriasis, obese individuals with psoriasis indicated more severe alexithymia (p<.001), more difficulties in emotional regulation, anxiety, depression, food cravings, and worse quality of life, including mental health-related quality of life(p<.05).				
		Alexithymia	Toronto Alexithymia Scale					
		Difficulties in emotional regulation	Difficulties in emotional regulation scale					
		Food cravings	Food cravings questionnaire trait					
		QoL	SF-12 Health survey					
		Depression	HASD					
		QoL	SF-12 Health survey	Mediation analysis	-	$\beta = -0.27$ [-0.48 – -0.06]	weak	0.05*
		Mental HRQoL	SF-12 Health survey	Mediation analysis;	-	$\beta = 0.53$ [0.06 – 1.28]	medium	0.05*
Crosta et al., 2014, Italy	Mild	Bulimic behaviours	EDIS	Group differences	0.76 [0.19 – 1.34]		medium	0.007*
Cakmur and Dervis, 2015, Turkey	Mild	QoL	DLQI	Group differences Lower weight vs. overweight	0.27 [-0.91 – 0.365]	-	Small	NR
				Group differences Normal weight vs. overweight	0.06 [-0.36 – 0.48]		weak	
Storer et al., 2018, USA	Mild	QoL	Based on Time (in years) to trade-off utility survey for living without obesity	Correlation	.2 [CI- NR]	-	weak	NR

(higher years reported suggest lower quality of life)								
Bronckers et al., 2016, Netherlands	Mild	QoL	DLQI	Correlation	DLQI	.03 [CI- NR]	weak	0.97
					EQ-5D	.24 [CI- NR]	small	.04*
		QoL	SF-36 Health Survey	Correlation	-	-.26 [CI- NR]	small	.03*
		QoL	EQ-5D	Regression	BMI was a significant predictor of quality of life			.001*
Barrea et al., 2016, Italy	Mild	QoL	DLQI	Correlation				
				BMI	-	.24 [CI- NR]	small	.001*
				WC	-	WC	Small	.001*
						.26 [CI-NR]-		
						WC, adjusted for BMI		
						.09 [CI-NR]	weak	.26

Adawiyah, 2017, Malaysia	Mild	Sexual dysfunction	MVFSFI	Correlation	0.29 [0.12-2.38]	-	small	NR
Molina-Leyva et al., 2013, Spain	Mild	Sexual dysfunction	MGH-SFQ	Correlation	-	$\beta = 0.9$ [0.4 – 2.2]	large	.82
Remrod, 2013, Sweden	Mild	Personality traits	SUSP	Correlations	-			
				Embitterment		$\beta = -0.3$ [-0.6 - 0.1]	Weak	0.17
				Irritability		$\beta = .02$ [-0.4 - 0.4]	Weak	0.92
				Mistrust		$\beta = 0.2$ [-0.3 - 0.6]	Weak	0.52
				Aggression		$\beta = 0.3$ [-0.1 - 0.8]	Weak	0.17
Lewinson et al., 2017, Italy	Mild	Depression	MDDRC	A lower proportion of patients with depression were obese (17.2%) compared to patients without depression (18.3%). Although the differences were significant ($p < .0001$), the % of non-obese was greater in the non-depressed group				
Tang et al., 2013, Malaysia	Mild	Mental health (general)	SF-12 health survey	Normal weight and overweight individuals with psoriasis scored equally on the mental health scale.				
			DLQI	Normal weight people with psoriasis and those with a BMI of more than 25 did not differ in terms of their mental health and quality of life.				
		Quality of Life						
Ryan et al., 2013, Dallas, Texas, and Dublin	Mild	Depression	CES-D	Conditional regression analysis were run and indicated that increase in BMI is associated with an increase in CES-D scores ($p = .007$).				
		Quality of Life		Conditional regression analysis indicated that increase in BMI is not significantly associated with an increase in DLQI scores ($p = .439$).				

		Relationship and sexual life	DLQI						Increase in BMI was significantly associated with a greater impairment in the relationship quality and sexual life of patients with psoriasis (p=.038)
			RSS						
Moderate-to-severe									
Sanchez-Carazo et al, 2014, Spain	61%-moderate psoriasis 39%-severe psoriasis	QoL	SF-12						BMI was associated with a decreased quality of life (p<.05), but not with mental health-related quality of life (p- not reported).
Tabolli et al., 2012, Italy	Moderate - Severe	Baseline depression and anxiety	GHQ	Correlation	-	$\beta = 0.10$ [-1.34 – 1.54]	weak	>0.05	
		Mental HRQoL ¹²	SF-36 Health Survey (mental health)	Correlation	-	$\beta = 1.40$ [-1.28 – 4.07]	large	>0.05	

¹² Studies also looked at physical and mental functioning which were assessed via either the Short Form-12 Health Survey (SF-12) or Short Form-36 Health Survey (SF-36). These tools are designed to assess self-reported health-related quality of life (HRQoL) and consist of two sub-scales- mental health component summary and physical health component summary. When used separately within the studies, this review reported any relevant data individually for each sub-scale, categorizing the variables as mental health-related quality of life and considering physical health-related quality of life as quality of life only.

		QoL	Skindex-29 ¹³	Correlation	-	Symptoms $\beta = -2.84$ [-8.03, 2.36] Emotion $\beta = -4.19$ [-9.67, 1.29] Social functioning $\beta = -4.00$ [-9.43, 1.43]	Large	>.05
		QoL	SF-36 Health Survey	Correlation	-	$\beta = -0.44$ [-2.73 – 1.85]	medium	
Kim et al., 2014, USA	Moderate -severe	Social anxiety Sexual relationships Sleep quality	Self-reported question items answered on a scale from 0 (not at all) to 3 (all the time)	Compared with normal weight patients, obese patients were more likely to perceive their general health as worse ($p < .001$), believed their psoriasis has caused weight gain ($p = .015$), view their weight as a problem ($p < .001$), experience sleep problems as a result of their psoriasis over lifetime ($p = .01$), hide their psoriasis over the last week ($p = .02$) and over lifetime ($p = .001$), have their self-confidence affected over the lifetime ($p = .006$) and over the last week ($p = .02$) as a result of psoriasis, avoid common activities as a result of psoriasis over lifetime ($p = .011$) and have used recreational drugs ($p = .012$).				
Sacmaci and Gurel, 2019, NR	Moderate - Severe	Subjective sleep quality	PSQI	Regression	0.55 [0.78 – 1.30]	-	medium	0.90

¹³ Negative coefficient indicates worsening of symptoms

Grozdev et al., 2012, USA	Moderate - Severe	Mental HRQoL	SF-12 Health survey	Correlation	$\beta = 0.10$ [-0.05 – 0.25]	weak	0.21
		QoL	SF-12 Health survey	Correlation	$\beta = -0.47$ [-0.63 – -0.32]	medium	0.001*

Table S2. Quality assessment using CASP

Questions / (inter-rater reliability %)	Authors						
	Lewinson et al. (2017)	Kim et al. (2014)	Storer et al. (2018)	Innamorati et al. (2016)	Tang et al. (2013)	Ryan et al. (2013)	Cohen et al. (2015)
1. Did the study address a clearly focused issue? (100%)	yes	yes	yes	yes	yes	yes	yes
2. Was the cohort recruited in an acceptable way (100%)	Can't tell	yes	Can't tell	no	yes	yes	no
3. Is it worth continuing? (100%)	yes	yes	yes	yes	yes	yes	yes
4. Was the exposure accurately measured to minimise bias? (100%)	yes	Can't tell	no	yes	yes	yes	no
5 (a). Was the outcome accurately measured to minimise bias? (94%)	yes	no	no	yes	yes	no	no
5 (b). Have the authors identified all important confounding factors? (84.4%)	no	no	no	no	yes	no	yes
6 (a). Have they taken account of the confounding factors in the design and/or analysis? (100%)	no	no	no	no	yes	no	yes
6 (b). Was the follow up of subjects complete enough? (100%)	yes	no	no	no	no	no	no
7. Was the follow up of subjects long enough? (100%)	yes	no	no	no	no	no	no
8. How precise are the results? (100%)	Precise enough	Precise enough	Not precise enough	Precise enough	Precise enough	Precise enough	Precise enough
9. Do you believe the results? (100%)	yes	yes	yes	yes	yes	yes	yes
10. Can the results be applied to the local population? (100%)	yes	Can't tell	Can't tell	Can't tell	Can't tell	Can't tell	Can't tell
11. Do the results of this study fit with other available evidence? (100%)	Can't tell	yes	Can't tell	yes	yes	Can't tell	yes
Overall quality of the study	moderate	low	low	moderate	moderate	moderate	low

Quality assessment cont. (1)

Questions

	Authors						
	Cakmur and Dervis (2015)	Crosta et al. (2014)	Skoie et al. 2017	Bronckers et al (2018)	Barrea et al (2016)	Grozdev et al. (2012)	Tabolli et al (2012)
1. Did the study address a clearly focused issue?	Yes	yes	yes	yes	yes	yes	yes
2. Was the cohort recruited in an acceptable way	yes	Can't tell	yes	yes	yes	no	yes
3. Is it worth continuing?	Yes	yes	yes	yes	yes	yes	yes
4. Was the exposure accurately measured to minimise bias?	Yes	yes	yes	yes	yes	yes	yes
5 (a). Was the outcome accurately measured to minimise bias?	Yes	yes	yes	yes	yes	yes	yes
5 (b). Have the authors identified all important confounding factors?	No	no	yes	yes	no	no	yes
6 (a). Have they taken account of the confounding factors in the design and/or analysis?	No	no	yes	yes	no	no	yes
6 (b). Was the follow up of subjects complete enough?	No	no	no	no	no	no	yes
7. Was the follow up of subjects long enough?	No	no	no	no	no	no	yes
8. How precise are the results?	Precise enough	Precise enough	Precise enough	Precise enough	Precise enough	Precise enough	Precise enough
9. Do you believe the results?	Yes	yes	yes	yes	yes	yes	yes
10. Can the results be applied to the local population?	Can't tell	Can't tell	yes	yes	Can't tell	Can't tell	yes
11. Do the results of this study fit with other available evidence?	Yes	Can' tell	yes	yes	Can't tell	yes	yes
Overall quality of the study	moderate	moderate	high	high	moderate	low	high

Quality assessment cont. (2)

Questions	Sanchez-Carazo et al 2014	Sacmaci and Gurel (2019)	Adawiyah (2017)	Molina-Leyva et al (2013)	Remrod (2013)
1. Did the study address a clearly focused issue?	Yes	yes	yes	yes	yes
2. Was the cohort recruited in an acceptable way	yes	yes	yes	yes	yes
3. Is it worth continuing?	Yes	yes	yes	yes	yes
4. Was the exposure accurately measured to minimise bias?	Can't tell	yes	Can't tell	Can't tell	yes
5 (a). Was the outcome accurately measured to minimise bias?	Can't tell	yes	Can't tell	Can't tell	yes
5 (b). Have the authors identified all important confounding factors?	Yes	yes	yes	yes	yes
6 (a). Have they taken account of the confounding factors in the design and/or analysis?	Yes	yes	yes	Can't tell	yes
6 (b). Was the follow up of subjects complete enough?	No	no	no	no	no
7. Was the follow up of subjects long enough?	No	no	no	no	no
8. How precise are the results?	Precise enough	Precise enough	Precise enough	Precise enough	Precise enough
9. Do you believe the results?	Yes	yes	yes	yes	yes
10. Can the results be applied to the local population?	Yes	Yes	Can't tell	yes	yes
11. Do the results of this study fit with other available evidence?	Yes	yes	yes	yes	yes
Overall quality of the study	moderate	high	moderate	moderate	high

Appendix B – The importance of illness severity and multimorbidity in the association between mental health and body weight in psoriasis-cross-sectional and longitudinal analysis related content

Supplementary Material A

Additional analysis

Supplementary Table A6: Comparison of demographic and illness -related variables between patients with available waist circumference and those with missing waist circumference at time one and at 12 months follow up

Variable		Time one (the first available data entry)					Follow-up (12 months later)				
		Waist circumference <i>present</i>	N	Wait circumference <i>missing</i>	N	p-value	Waist circumference <i>present</i>	N	Wait circumference <i>missing</i>	N	p-value
Gender, n (%)	Female	49.8%	128	50.2%	129	0.008*	59.0%	69	41.0%	48	0.367
	Male	60.0%	282	40.0%	188		63.9%	154	36.1%	87	
Age (year), mean (SD)		46.04 (13.57)	410	46.01 (12.83)	317	0.0978	45.56 (12.65)	223	45.33 (13.13)	135	0.869
Ethnicity n (%)	White	57.1%	333	42.9%	250	0.383	62.5%	178	37.5%	107	0.898
	Black and Ethnic minorities	53.1%	77	46.9%	68		61.6%	45	38.4%	28	
Treatment n (%)	Taking either biologic or systemic treatment, yes	55.2%	232	44.8%	188	0.843	66.4%	144	33.6%	73	0.041*
	No systemic treatment, yes	56.0%	154	44.0%	121		55.4%	72	44.6%	58	
PASI, mean (SD)		4.67 (5.08)	395	5.30 (5.25)	308	0.106	3.44 (4.36)	221	4.35 (4.50)	135	0.06

Total number of comorbid medical conditions, mean (SD)		0.93 (1.34)	198	1.22 (1.21)	115	0.058	0.93 (1.34)	198	1.22 (1.21)	115	0.058
Depression (PHQ), n (%)	Depressed	58.9%	86	41.1%	60	0.481	64.1%	34	35.9%	19	0.762
	Not depressed	55.7%	324	44.3%	277		62.0%	189	38.0%	116	
Anxiety (GAD), n (%)	Anxious	56.3%	71	43.7%	49	0.491	75.0%	30	25.0%	10	0.078
	Not anxious	55.8%	339	44.2%	269		60.7%	193	39.3%	125	

Supplementary Table A7: Comparison of demographic and illness -related variables between patients with available BMI and those with missing BMI at time one and at 12 months follow up

		Time one (the first available data entry)					Follow-up (12 months later)				
Variable		BMI <i>present</i>	N	BMI <i>missing</i>	N	p-value	BMI <i>present</i>	N	BMI <i>missing</i>	N	p-value
Gender, n (%)	Female	65.4%	168	34.6%	89	0.873	76.1%	89	23.9%	28	0.624
	Male	66.0%	310	34.0%	160		76.8%	185	23.2%	56	
Age (year), mean (SD)		45.66 (13.29)	478	46.73 (13.15)	249	0.301	45.33 (12.98)	274	45.92(12.39)	84	0.715
Ethnicity, n (%)	White	34.0%	198	66.0%	385	0.666	75.8%	216	24.2%	69	0.510
	Black and Ethnic minorities	35.9%	52	64.1%	93		79.5%	58	20.5%	15	
Treatment, n (%)	Taking either biologic or systemic treatment, yes	64.3%	270	35.7%	150	0.19	72.8%	158	27.2%	59	0.03*
	No systemic treatment, yes	69.1%	190	30.9%	85		83.1%	108	16.9%	22	
PASI, mean (SD)		5.30 (5.81)	468	4.76 (4.80)	235	0.189	3.67 (4.01)	272	4.15 (5.58)	84	0.385
Total number of comorbid medical conditions, mean (SD)		1.02 (1.32)	421	0.83 (1.22)	224	0.08	1.10 (1.35)	240	0.84 (1.1)	73	0.134

Depression (PHQ), n (%)	Depressed	44.5%	65	55.5%	81	0.004*	79.3%	42	20.7%	11	0.614
	Not depressed	68.2%	397	31.8%	185		76.1%	232	23.9%	73	
Anxiety (GAD), n (%)	Anxious	60.0%	72	40.0%	48	0.153	80.0%	32	20.0%	8	0.583
	Not anxious	66.8%	406	33.2%	202		76.1%	242	23.9%	76	

Supplementary Table A8: Exploratory bivariate associations between predictors and outcomes at time one and at 12 months follow-up

Predictors	Outcomes at time one		Outcomes at 12 months follow up	
	BMI	Waist circumference	BMI	Waist circumference
Age	r= 0.20, p<0.001*	r= 0.20, p<0.001*	r= 0.20, p= 0.0009*	r= 0.34, p< 0.001*
Gender	r= 0.02, p= 0.679	r= 0.18, p= 0.0002*	r= 0.06, p= 0.316	r= 0.25, p= 0.0002*
Ethnicity	r= 0.07, p= 0.147	r= 0.03, p= 0.489	r= 0.09, p= 0.12	r= 0.12, p= 0.06
Treatment type	r= -0.06, p= 0.217	r= -0.05, p= 0.361	r= 0.04, p= 0.503	r= -0.06, p= 0.355
Number of comorbidities	r= 0.24, p<0.001*	r= 0.23, p<0.001*	r= .35, p< 0.001*	r= 0.22, p< 0.001*
PASI scores	r= 0.05, p= 0.244	r= 0.06, p=0.247	r= 0.19, p= 0.004*	r= 0.06, p= 0.35
Depression	r= 0.01, p=0.908	r= 0.09, p=0.06	r= 0.08, p= 0.21	r= 0.04, p= 0.52
Anxiety	r= -0.03, p=0.583	r= 0.074, p= 0.131	r= 0.001, p= 0.979	r= 0.10, p= 0.113

Supplementary Table A9: Depression and anxiety at time one and waist circumference at time one, using gender as moderator after controlling for demographic and illness-related variables

<i>Step and variable</i>	<i>B</i> (standard error)	Significance level (2-tailed)	95% Confidence Interval*		R ² Change
			Lower	Upper	
N= 326					
Gender, male	8.22 (2.15)	≤0.001*	4.00	12.44	14.72%

Depression, present	-0.84 (6.75)	0.902	-14.12	12.45
Gender, male	3.52 (8.41)	0.676	-13.02	20.06
Depression, present	-1.08 (7.24)	0.881	-15.33	13.17
Anxiety, present	-7.20 (11.50)	0.531	-29.82	15.41
Gender, male				
Anxiety, present				
Age	0.20 (0.07)	0.006*	0.06	0.34
Ethnicity, white present	1.87 (2.16)	0.387	-2.38	6.13
Number of comorbidities	2.13 (0.72)	0.004*	0.70	3.55
Psoriasis systemic treatment	1.47 (1.78)	0.411	-2.04	4.97
PASI	0.14 (0.22)	0.538	-0.30	0.57

Supplementary Table A10: Depression and anxiety at time one and BMI at time one, using gender as moderator after controlling for demographic and illness-related variables

<i>Step and variable</i>	<i>B</i> (standard error)	Significance level (2- tailed)	95% Confidence Interval*		R ² Change
			Lower	Upper	
N= 399					
Gender, male	0.32 (0.67)	0.414	-2.79	6.76	11.29%
Depression, present	1.99 (2.43)	0.635	-1.00	1.63	
Gender, male	-1.30 (3.00)	0.665	-7.21	4.61	
Depression, present	-1.36 (2.56)	0.594	-6.39	3.66	
Anxiety, present					

Gender, male	-0.73	0.837	-7.73	6.27
Anxiety, present	(3.56)			
Age	0.06	0.006*	0.02	0.11
	(0.02)			
Ethnicity, white present	0.76	0.275	-0.61	2.13
	(0.70)			
Number of comorbidities	0.87	≤0.001*	0.41	1.32
	(0.23)			
Psoriasis systemic treatment	0.88	0.130	-0.26	2.02
	(0.58)			
PASI	0.09	0.223	-0.06	0.24
	(0.08)			

Supplementary Table A11: Depression and anxiety at the first data entry and waist circumference at 12 months follow up, using gender as moderator after controlling for demographic and illness-related variables

<i>Step and variable</i>	<i>B</i> (standard error)	Significance level (2- tailed)	95% Confidence Interval*		R ² Change
			Lower	Upper	
N= 191					
Gender, male	6.74	0.007*	1.87	11.61	30.95%
	(2.47)				
Depression, present	1.30	0.872	-14.63	17.24	
	(8.07)				
Gender, male	-3.16	0.784	-25.85	19.52	
Depression, present	(11.49)				
Anxiety, present	2.83	0.725	-13.04	18.70	
	(8.04)				
Gender, male	-14.53	0.266	-40.21	11.14	
Anxiety, present	(13.01)				
Age	0.27	0.337	-18.82	54.62	
	(0.09)				
Ethnicity, white present	4.63	0.070	-0.38	9.63	
	(2.54)				
Number of comorbidities	2.57	0.003*	0.88	4.27	

Psoriasis systemic treatment	(0.86) 0.19 (2.19)	0.931	-4.14	4.52
PASI	1.19 (0.28)	≤0.001*	0.64	1.74

Supplementary Table A12: Depression and anxiety at the first data entry and BMI at 12 months follow up, using gender as moderator after controlling for demographic and illness-related variables

<i>Step and variable</i>	<i>B</i> (standard error)	Significance level (2- tailed)	95% Confidence Interval*		R ² Change
			Lower	Upper	
N= 231					
Gender, male	0.62 (0.94)	0.512	-1.24	2.48	10.23%
Depression, present	0.43 (2.48)	0.862	-4.45	5.32	
Gender, male Depression, present	-4.33 (3.56)	0.226	-11.35	2.69	
Anxiety, present	-1.59 (3.42)	0.641	-8.33	5.14	
Gender, male Anxiety, present	-2.27 (6.98)	0.746	-16.02	11.49	
Age	0.05 (0.03)	0.102	-0.01	0.12	
Ethnicity, white present	1.15 (0.94)	0.222	-0.70	2.30	
Number of comorbidities	0.70 (0.33)	0.033*	0.06	1.35	
Psoriasis systemic treatment	0.65 (0.81)	0.420	-0.94	2.24	
PASI	0.12 (0.11)	0.268	-0.09	0.34	

Supplementary Table A13: Comparison on multimorbidity and PASI between patients with or without depression and anxiety at time one

	Depressed (N=117)	Not depressed (N= 528)	p	Anxious (N=97)	Not anxious (N=548)	p
Number of comorbidities Mean, SD	M= 0.71, SD= 1.23	M= 1.00, SD= 1.30	0.02*	M= 0.66, SD= 1.23	M= 1.00, SD= 1.29	0.01*
	Depressed (N=139)	Not depressed (N= 564)	p	Anxious (N=116)	Not anxious (N=587)	p
PASI Mean, SD	M= 6.68, SD= 0.58	M= 4.52, SD= 0.19	p≤ 0.001*	M= 6.23, SD= 0.59	M= 4.69, SD= 0.20	0.003*

Supplementary Material B

eMethods

Patient Health Questionnaire (PHQ) and Generalised Anxiety Disorder Scale (GAD)

All participants completed PHQ-2¹ and GAD-2², consisting of the first two items of PHQ-9 and GAD-7, respectively. Participants answering positively (‘More than half the days’ or ‘Nearly every day’) to at least one item went on to complete the remaining items of the corresponding measure. Probable major depressive disorder (MDD; ‘depression’ in the manuscript) was defined in accordance with the DSM-V criteria³ as (i) responding positively to one of the first two items (‘Little interest or pleasure in doing things’, ‘Feeling down, depressed, or hopeless’); and (ii) responding positively to a minimum of five other depression symptoms. If one of the reported symptoms was suicidality (“Thoughts that you would be better off dead, or of hurting yourself”), an answer of ‘Several days or more’ often would indicate a positive response. Probable generalized anxiety disorder (GAD; ‘anxiety’ in the manuscript) was defined as (i) responding positively to one of the first two items (“Feeling nervous, anxious, or on edge”, or “Not being able to stop or control worrying”); and (ii) a total score of ≥ 10 (out of a total of 21).

eReferences

1. Kroenke K, Spitzer R, Williams J. The Patient Health Questionnaire-2: Validity of a Two-Item Depression Screener. *Med Care*. 2003;41(11):10.
2. Spitzer RL, Kroenke K, Williams JBW, Löwe B. A Brief Measure for Assessing Generalized Anxiety Disorder: The GAD-7. *Arch Intern Med*. 2006;166(10):1092-1097.
doi:10.1001/archinte.166.10.1092

3. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*. 5th edition. American Psychiatric Association; 2013.

Supplementary Material C

Strengthening the Reporting of Observational Studies in Epidemiology

(STROBE) checklist

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

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1	The importance of illness severity and multimorbidity in the association between mental health and body weight in psoriasis: cross-sectional and longitudinal analysis
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3	
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-5	
Objectives	3	State specific objectives, including any prespecified hypotheses	5	
Methods				
Study design	4	Present key elements of study design early in the paper	6	

Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6	
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	6	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-8	
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7-8	
Bias	9	Describe any efforts to address potential sources of bias	8	First, to investigate the impact of missing data, patients with and without outcome data (waist circumference and BMI) at time one and follow-up were compared for demographic, illness-related, and mental health variables
Study size	10	Explain how the study size was arrived at	6	To maximise the use of available data, three analytical samples were defined (Table 1) all of which had complete data on either BMI or waist circumference, on covariates (e.g., demographic, illness-related), and mental health variables (depression and anxiety). Patients with incomplete data on BMI or waist circumference, covariates (e.g., demographic, illness-related), or mental health variables (depression and anxiety) were excluded from the analytical samples.

Continued on next page

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8-9
		(b) Describe any methods used to examine subgroups and interactions	8-9
		(c) Explain how missing data were addressed	8-9
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	Table 2.
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9-10
		(b) Indicate number of participants with missing data for each variable of interest	10
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	12-13
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	12-13
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12-13
		(b) Report category boundaries when continuous variables were categorized	12-13
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A

Continued on next page

Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	13	
Discussion				
Key results	18	Summarise key results with reference to study objectives	13-14	
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16	
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14-15	
Generalisability	21	Discuss the generalisability (external validity) of the study results	15-17	
Other information				
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	1	This paper represents independent research part-funded by the National Institute for Health Research (NIHR) Maudsley Biomedical Research Centre at South London and Maudsley NHS Foundation Trust and King's College London and NIHR Biomedical Research Centre (BRC) at Kings College London and Guys and St Thomas NHS Foundation Trust. The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health and Social Care.

Appendix C - ‘I don’t know which is the chicken and which is the egg’: A qualitative study of weight loss-related beliefs and behaviours among adults with psoriasis and comorbid obesity related content

Standards for Reporting Qualitative Research (SRQR)*

<http://www.equator-network.org/reporting-guidelines/srqr/>

Page/line no(s).

Title and abstract

Title - Concise description of the nature and topic of the study Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended	Page 1
Abstract - Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions	Page 1, Title page

Introduction

Problem formulation - Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement	Pages 1-4
Purpose or research question - Purpose of the study and specific objectives or questions	Page 4

Methods

Qualitative approach and research paradigm - Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., postpositivist, constructivist/interpretivist) is also recommended; rationale**	Page 5
Context - Setting/site and salient contextual factors; rationale**	Pages 5
Sampling strategy - How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale**	Page 6
Ethical issues pertaining to human subjects - Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues	Page 5
Data collection methods - Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale**	Page 6
Data collection instruments and technologies - Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study	Page 6

Units of study - Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results)	Page 7
Data processing - Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymization/de-identification of excerpts	Page 6
Data analysis - Process by which inferences, themes, etc., were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale**	Page 7 and Table 4
Techniques to enhance trustworthiness - Techniques to enhance trustworthiness and credibility of data analysis (e.g., member checking, audit trail, triangulation); rationale**	Table 4

Results/findings

Synthesis and interpretation - Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory	Pages 7-8, Table 3 and Figure 1
Links to empirical data - Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings	Pages 8-17

Discussion

Integration with prior work, implications, transferability, and contribution(s) to the field - Short summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline or field	Pages 18-21
Limitations - Trustworthiness and limitations of findings	Pages 21-22

Other

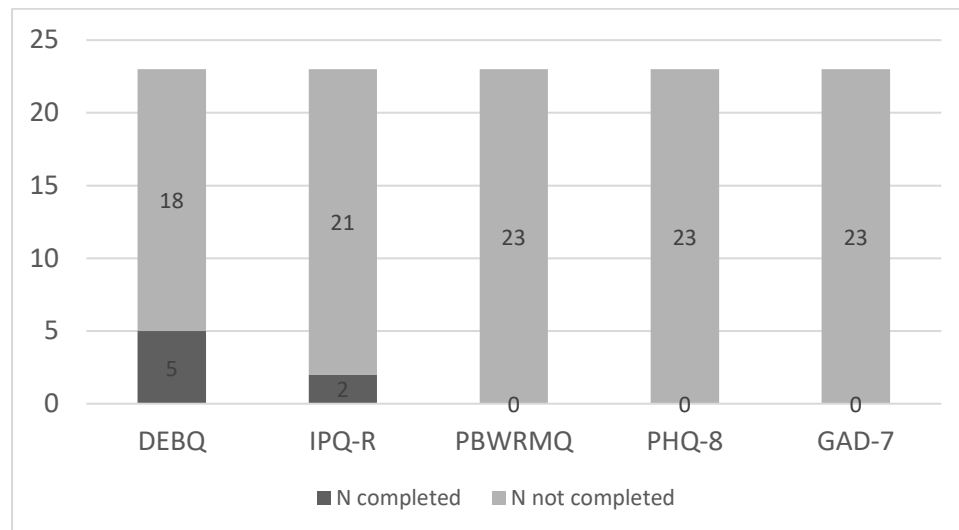
Conflicts of interest - Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed	Title page
Funding - Sources of funding and other support; role of funders in data collection, interpretation, and reporting	Title page

*The authors created the SRQR by searching the literature to identify guidelines, reporting standards, and critical appraisal criteria for qualitative research; reviewing the reference lists of retrieved sources; and contacting experts to gain feedback. The SRQR aims to improve the transparency of all aspects of qualitative research by providing clear standards for reporting qualitative research.

**The rationale should briefly discuss the justification for choosing that theory, approach, method, or technique rather than other options available, the assumptions and limitations implicit in those choices, and how those choices influence study conclusions and transferability. As appropriate, the rationale for several items might be discussed together.

Appendix D - Emotional eating and illness perceptions, but not depression and anxiety, are associated with high body weight in psoriasis: a cross-sectional study related content

Figure S1. Responses to questionnaires in people who completed the survey partly (N=23)



DEBQ = Dutch Eating Behaviour Questionnaire; IPQ-R = Illness Perceptions Questionnaire – Revised; PBWRMQ – Psoriasis and Body Weight Representations and Management Questionnaire (adapted from DDRMQ); PHQ-8 = Patient Health Questionnaire – 8; GAD-7 = Generalized Anxiety Disorder – 7.

Supplementary Table S1: Comparison of demographic and illness -related variables between patients with fully available data on explanatory variables and those with missing data on explanatory variables

Variable		Available data	N	Partly available data	N	p-value
Gender, n (%)	Female	77.2%	129	52.2%	12	0.644
	Male	22.8%	38	47.8%	11	
Age (year), mean (SD)		46.04 (13.6)	167	45.73 (12.13)	23	0.715
Ethnicity, n (%)	White	86.8%	145	91.3%	21	0.710
	Black and Ethnic minorities	13.2%	22	8.7%	2	
Treatment, n (%)	Taking systemic treatment, yes	44.9%	75	56.5%	13	0.534
	No systemic treatment, yes	55.1%	92	43.5%	10	
Onset of psoriasis diagnosis n (%)	Early onset (before age of 40)	81.4%	136	60.9%	14	0.162
	Late onset (after age of 40)	18.6%	31	39.1%	9	
Years living with psoriasis, n (%)	Less than 5 years/	43.7%	73	47.8%	11	0.724
	Between 5 and 10 years					
	More than 10 years/ More than 20 years	56.3%	94	56.5%	13	

Total number of comorbid medical conditions, mean (SD)	2.0 (1.40)	167	1.83 (1.22)	23	0.134
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Supplementary Table S2. The association between depression and BMI, using emotional eating as moderator after controlling for demographic and illness-related variables

BMI	Coef.	St.Err.	t-value	p-value	[95% Conf Interval]	Sig
Depression	.023	.686	0.03	.974	-1.333 1.378	
Emotional eating	.185	.109	1.70	.091	-.03 .399	
Depression##Emotional eating	-.001	.014	-0.06	.952	-.028 .026	
Age	-.055	.059	-0.92	.357	-.172 .062	
Sex, female	3.461	1.42	2.44	.016	.656 6.267	**
Ethnicity, White	-4.361	1.639	-2.66	.009	-7.599 -1.124	***
Smoking status, smoker	2.105	.788	2.67	.008	.548 3.662	***
Alcohol, at least twice a week or more	-.057	.349	-0.16	.87	-.748 .633	
Years living with psoriasis, total	.826	.471	1.75	.081	-.104 1.756	
Systemic treatment, present	.913	1.198	0.76	.447	-1.453 3.279	
Comorbidities, total	-.131	.547	-0.24	.811	-1.211 .949	

Supplementary Table 3. The association between depression and waist circumference, using emotional eating as moderator after controlling for demographic and illness-related variables

Waist circumference	Coef.	St.Err.	t-value	p-value	[95% Conf Interval]	Sig
Depression	.048	.027	1.76	.081	-.006 .102	
Emotional eating	.001	.005	0.21	.831	-.009 .011	
Depression##Emotional eating	-.001	.001	-1.66	.099	-.002 .001	
Age	.003	.003	1.08	.282	-.003 .009	
Sex, female	-.041	.076	-0.54	.591	-.191 .109	
Ethnicity, White	-.082	.08	-1.03	.305	-.241 .076	
Smoking status, smoker	-.057	.045	-1.28	.203	-.146 .031	
Alcohol, at least twice a week or more	.047	.024	1.99	.048	0 .094	**
Years living with psoriasis, total	-.042	.027	-1.55	.124	-.096 .012	
Systemic treatment, present	-.149	.075	-1.99	.048	-.298 -.001	**
Comorbidities, total	.034	.03	1.14	.258	-.025 .093	

Supplementary Table S4. The association between emotional eating and BMI, using physical activity as moderator after controlling for demographic, lifestyle, and illness-related variables

	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
BMI							
Emotional eating	.195	.093	2.10	.037	.012	.378	**
Physical activity	.007	.058	0.12	.907	-.109	.122	
Emotional eating##Physical activity	0.001	.001	-0.28	.782	-.003	.002	
Age	-.06	.057	-1.04	.298	-.173	.053	
Sex, female	3.44	1.416	2.43	.016	.644	6.236	**
Ethnicity, White	-4.414	1.592	-2.77	.006	-7.559	-1.269	***
Smoking status, smoker	2.269	.819	2.77	.006	.652	3.887	***
Alcohol, at least twice a week or more	-.044	.36	-0.12	.902	-.756	.668	
Years living with psoriasis, total	.931	.521	1.79	.076	-.098	1.959	*
Systemic treatment, present	.837	1.165	0.72	.474	-1.465	3.139	
Comorbidities, total	-.157	.59	-0.27	.79	-1.322	1.007	

Supplementary Table 5. The association between emotional eating and waist circumference, using physical activity as moderator after controlling for demographic, lifestyle, and illness-related variables

	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Waist circumference							
Emotional eating	-.007	.003	-2.02	.046	-.013	0	**
Physical activity	.001	.002	0.49	.623	-.004	.006	
Emotional eating##Physical activity	0.001	0.001	-0.33	.744	0.001	0.002	
Age	.003	.003	0.98	.33	-.003	.009	
Sex, female	-.055	.078	-0.70	.487	-.21	.1	
Ethnicity, White	-.067	.084	-0.79	.429	-.233	.1	
Smoking status, smoker	-.045	.043	-1.05	.295	-.13	.04	
Alcohol, at least twice a week or more	.047	.024	1.94	.054	-.001	.095	
Years living with psoriasis, total	-.052	.028	-1.86	.064	-.107	.003	
Systemic treatment, present	-.145	.076	-1.90	.059	-.295	.005	
Comorbidities, total	.031	.03	1.05	.295	-.028	.091	