

QUALITY OF LIFE IN PATIENTS WITH KELOIDS IN THE CONTEXT OF MARGINALIZED IDENTITIES: PILOT STUDY AND LITERATURE REVIEW

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ABSTRACT

Keloids are hyperproliferative scars that are most prevalent in African, Latinx and Asian populations and remain a significant burden on quality of life (QoL) as treatment can be difficult, painful and often unsuccessful. A pilot study was conducted at UConn Health to assess the results of clinical and psychosocial QoL impact surveys of 30 keloid patients. Results of this pilot study indicate that intersecting marginalized identities may increase the negative effects of keloids on patient QoL. Black female patients showed strong positive correlation of $r=0.59$ for number of keloids and number of symptoms reported (itching, painful, throbbing and burning), $p < 0.10$. A moderate positive correlation of $r=0.46$ was also found for Black female patients with the number of attempted keloid removals and number of negative feelings reported (worried, angry, sad and guilty). We also present a systematic review of the current keloid QoL literature to better understand questionnaire results in the context of intersecting marginalized identities and health disparities. Predefined criteria were used to identify and screen articles, within the period of March 2006 through May 2019, with a total of 10 articles that passed the criteria. A previously published intersectional analysis was utilized to analyze these keloid QoL studies to identify potential research disparities. Results of this intersectional analysis indicate that race and gender may add to a greater negative impact on keloid QoL in marginalized patients due to unacknowledged disparities in keloid QoL research studies. These results emphasize the need for greater inclusivity with regards to race and gender in keloid QoL questionnaires and studies to better assess keloid QoL impact on marginalized populations.

INTRODUCTION

Keloids consist of hyperproliferative fibrotic tissue of the dermis that expands beyond the original wound border after trauma (Ud-Din and Bayat, 2013). Keloids are benign tumors and develop as an immune response to cuts, surgery, acne, infections, ear piercings and lacerations, with some patients reporting no evident cause (Ud-Din and Bayat, 2020). Keloids can vary in symptoms, size, location and can persist for many years (Bayat et al., 2005). Most patients are symptomatic, as keloids can be inflamed, itchy, painful, bleed and can cause burning sensations (Ud-Din and Bayat, 2013). Most common treatments include cortisone injections, surgical excision, laser treatment, topical creams, radiotherapy, 5-FU injection, cordran tape, pressure treatment, cryotherapy or silicone gel sheeting (Limmer and Glass, 2020; Ogawa et al., 2020). However, success rates of keloid treatments are highly variable and can be a source of

frustration to both, patients and clinicians (Gold et al., 2020; Leventhal et al., 2006; Ogawa et al., 2016).

Keloids are most prevalent in Black, Latinx and Asian populations (Furtado et al., 2009; Lyons et al., 2019; Seifert and Mrowietz, 2009; Tran et al., 2019) and pose a significant burden on quality of life (QoL) due to variable success rates of treatment methods used to alleviate appearance and symptoms. Patients with keloids can experience reduced mobility and pain or tenderness of the lesions that can impact daily life (Olaitan et al., 2011; Seifert and Mrowietz, 2009). Psychosocial parameters, such as visible or disfiguring keloids leading to real or perceived stigmatization, may cause personal insecurity and social and economic disadvantages (Furtado et al., 2009; Guy et al., 2015; Lyons et al., 2019). Stigmatization due to disease such as keloids, has been seen to increase the difficulty in managing and treating diseases (Conrad and Barker, 2010). Keloids are also viewed as a chronic inflammatory condition (Tan et al., 2019), similar to other chronic cutaneous disorders, which detrimentally impact clinical and psychosocial QoL such as psoriasis and vitiligo (Bae et al., 2018; Furtado et al., 2009; Langley et al., 2005).

When considering keloid disease management in the United States, health disparities must be considered, especially in keloid QoL questionnaires as reported outcomes of these QoL surveys are known to be impacted by socio-demographic factors (Jalali-Farahani et al., 2017). While keloids can occur in all races and ethnicities, most patients with keloids are found in marginalized and medically underserved Black, Latinx and Asian populations (Vu et al., 2019) in the United States. Marginalized identities are those that identify as part of historically underprivileged groups (Black, Indigenous, people of color, LGBTQIA+, disabled or with low socioeconomic status) (Brutschy and Zachary, 2014; Seng et al., 2012; Vu et al., 2019). Intersectionality is a term that describes the intersecting effects of marginalized race, class, gender, and other characteristics that contribute to social identity and affect health (Seng et al., 2012; Vu et al., 2019). Having been heavily researched, patients of marginalized identities suffer from discrimination, racism, aversive racism and lack of access to care, which increases risks for a variety of diseases, like hypertension, cancer, maternal morbidity, diabetes and mental health issues (Gravlee, 2009; Seng et al., 2012; Wong, 2015). To better understand the impact of keloids on marginalized populations, comprehensive keloid QoL

questionnaires are necessary to evaluate accurate health outcomes with relevance to socio-demographic factors in order to improve treatment management and health equity.

Tran and colleagues observed a potential interaction between race, gender and keloid-related stigma, as Black men with keloid disease exhibited more stress-mediated biological responses compared to other intersecting race and gender groups (Tran et al., 2019). This points to how social factors responsible for race-based disparities in disease experience and outcomes drive biological responses and consequently management and treatment (Conrad and Barker, 2010). It was suggested that keloid QoL questionnaires were geared towards more fair-skinned patients, leading to disparities in keloid QoL research and disease management (Lyons et al., 2019).

The framework for the study presented here used established methods from both clinical research and social scientific intersectional methods in order to holistically understand keloids in the context of biological responses and the social processes affecting this disease. We utilized the “intercategorical complexity” approach to intersectionality in research as defined by McCall 2005, which analyzes the structural relationships of intersecting race and gender, and other categories, to expose present health inequities for our purposes (McCall, 2005).

METHODS

Pilot Study

A pilot study was conducted to better understand the impact of intersecting marginalized identities as a contributing factor to increased negative impact on QoL in keloid patients. Over a ten-year period, patients who enrolled in a keloid study at UConn Health had the option to respond to a clinical and psychosocial QoL impact questionnaire. Eligibility of patients was determined if scars were distinct from hypertrophic scarring. Of the patients participating in our genetic study, a total of 30 patients chose to complete the optional QoL questionnaire. All patients were based in the United States and enrolled and consented with approval of the University of Connecticut Health Institutional Review Board (IRB#03-007). To determine convergent validity of clinical and psychosocial impact we utilized Pearson's correlation coefficient, with a strong positive correlation if $r \geq 0.5$. Interactions in the intersectionality of sex (male and female) and race was analyzed in an “intercategorical

complexity” approach by these correlation coefficients (McCall, 2005).

Systematic Review

A comprehensive and systematic literature review following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2015) utilized Google Scholar, PubMed and SCOPUS databases. The search term “keloid impact on quality of life” was applied when searching the databases. Prior to screening, all duplicates were removed. Two reviewers independently screened the articles for eligibility by title and abstract. Full-text publications were then reviewed based on exclusion criteria. Articles were excluded for the following reasons: not specifically about keloid impact on QoL; not involving clinical/psychosocial outcome measures; not accessible after exhaustive search; not available in English and/or not original research publications. Included were articles discussing keloid clinical and psychosocial impact on quality of life published in English for the period of March 2006 through May 2019. A spreadsheet was generated to record findings for each article.

RESULTS

Quality of Life Pilot Study Results

Of the total number of patients who returned the QoL questionnaire, 17 identified as Black, four as White, three as Pacific Islander, three as Other (two or more races), two as Asian and one as Latinx (Table 1). Male to female ratio in this study sample was 7 Male and 8 Female, or 0.53 (Table 1). We report convergent validity between the psychosocial and clinical impact surveys of keloids on marginalized identities, with a strong positive correlation of $r=0.59$ for number of keloids and number of symptoms reported (itching, painful, throbbing and burning), $p < 0.10$ in Black female patients (Table 1). A moderate positive correlation of $r=0.46$ was also found for Black female patients with the number of attempted keloid removals and number of negative feelings reported (worried, angry, sad and guilty) (Table 1). This pilot study confirmed a positive correlation for the intersectionality of marginalized identities, specifically in Black female patients, increasing the negative clinical and psychosocial impact of keloids on quality of life. Due to limitations in the QoL questionnaire, these results interpret gendered perceptions as biological sex, with no patient comments on questionnaires to indicate otherwise. Numbers and

locations of keloids in individual patients could not be correlated to their perceived psychological and social impact due to the small number of respondents in the study (Table 2). It is noteworthy that most patients had several keloids and many were in visible areas of the body. Most patients reported several irritating symptoms of their keloids (itching, burning, pain, throbbing).

Systematic Review: Study Comparisons

Out of total 34 publications identified with the search term “keloid impact on quality of life” (4 SCOPUS, 11 PubMed, 19 Google Scholar), 24 were non-duplicate records. A total of 12 articles were excluded based on title and abstract. 12 full-text articles were eligible to be reviewed. Only 10 studies met all inclusion parameters and were included in the final systematic review (Figure 1). These 10 studies analyzed the impact of keloids on QoL and/or the psychosocial and clinical impact on QoL. There was variability in study design and focus, questionnaire design and relationships of keloids with demographics. Sample size of these studies ranged from 25 to 131 patients. There were varying male to female patient ratios from 0.52 to 1.28 and a mean age of 27-39 years. Patients in all studies were sampled from academic hospitals (Table 3). Quality of life was measured by 15 different questionnaires. Several studies used more than one questionnaire to assess varying issues in their keloid patients. 11 questionnaires assessed for physical and clinical QoL measurements and four assessed for psychosocial QoL measurements. One questionnaire (Bock et al., 2006) was developed by researchers and 14 were more general and had been published elsewhere. Four of those questionnaires were generic and applicable to all diseases (Bijlard et al., 2017; Furtado et al., 2012; Kouwenberg et al., 2015; Lemonas et al., 2015), five were specific to dermatologic diseases (Balci et al., 2009; Bijlard et al., 2017; Furtado et al., 2012; Kouwenberg et al., 2015; Lemonas et al., 2015), four were specific to psychiatric evaluations (Furtado et al., 2012; Motoki et al., 2019) and one was specific for keloid disease (Furtado et al., 2012; Furtado et al., 2009) (Table 3). None of these questionnaires or studies assessed the relationship of health disparities correlating to patient demographics as additive effects on keloid QoL impact.

Keloid-related Quality of Life Studies in Literature

Clinical and psychosocial parameters of QoL were analyzed in 9 out of the 10 papers, with the remaining paper being a literature review on keloid QoL (Ud-

Din and Bayat, 2013). Of the other 9 papers, one paper (Olaitan, 2009) did not find a large clinical or psychosocial impact in Nigerian keloid patients and concluded that patients in areas where keloids were more common suffered less from QoL impacts compared to counterparts in regions with lower keloid prevalence. The remaining 8 publications observed a statistically significant clinical and psychosocial impact of keloids on QoL, with correlation between clinical and psychosocial impact. Two articles (Bijlard et al., 2017; Kouwenberg et al., 2015) (Table 3), utilizing the same five questionnaires (POSAS, Skindex-29, HRQL; SF-36, EQ-5D-5L), found lower sum scores in the SF-36 questionnaire, which is a generic short health survey measuring physical and mental health (Ware, 2000), and lower scores in the EQ-5D-5L questionnaire (0.80 and -0.54, respectively), a generic questionnaire to evaluate health (Herdman et al., 2011). Both studies also found low sum scores on the Skindex-29, which focuses on dermatology diseases on clinical and psychological impact on QoL (Chren, 2012). Both studies had 106 patients, conducted the surveys in a university hospital setting and concluded that pain and itch were the highest burdens for QoL of keloid patients. Bijlard and colleagues stated the need for effective treatments and priority when considering health policy decisions (Bijlard et al., 2017). Two articles utilizing the DLQI, a widely used dermatology HRQOL questionnaire (Batra et al., 2008), both found strong Cronbach alpha scores for internal consistency of $\alpha = 0.78$ (Balci et al., 2009) and $\alpha = 0.86$ (Lemonas et al., 2015). Of the remaining articles, six had varying questionnaires with specific parameters to their study designs (Bock et al., 2006; Furtado et al., 2012; Furtado et al., 2009; Lemonas et al., 2015; Motoki et al., 2019; Olaitan, 2009) and observed statistically significant clinical and psychosocial impacts from their respective questionnaires.

Overall, studies found that keloids have physical impact on QoL, with pain and itch as the highest burden (Table 4). Of the 9 studies analyzing clinical and psychosocial parameters of QoL, one study specifically mentions disease duration as an impact on QoL (Olaitan, 2009) and two studies observed QoL impact due to keloid distribution (Olaitan, 2009; Ud-Din and Bayat, 2013) with visible/non visible keloids and presternal keloids having clinical and psychosocial impact. Psychosocial impacts on QoL were reported as increased stigmatization, lowered self-esteem and overall psychosocial impairment

(Table 4). In the context of social impact, keloids were reported to negatively impact social functioning.

Keloids: Race, Gender Perceptions and Age

Out of the nine papers discussing keloid QoL impact, the race of patients was not mentioned in three publications (Balci et al., 2009; Bock et al., 2006; Ud-Din and Bayat, 2013). In the study by Olaitan et al., which was conducted in Nigeria, all patients were of African descent (Olaitan, 2009). For the 5 remaining studies, the Fitzpatrick scale skin type, a skin color scale (Sachdeva, 2009) or race was stated (Bijlard et al., 2017; Furtado et al., 2012; Furtado et al., 2009; Lemonas et al., 2015; Motoki et al., 2019). In the publication by Furtado et al. (2009), 68.6% of the 102 patients were of African descent, noting that keloid patients had no skin color distinction and the race of the remaining 31.4% was not mentioned. In Bijlard et al., 21.7% of 106 patients were with Fitzpatrick scale I-II (Light), 41.5% within III-IV (Medium) and 35.8% within V-VI (Dark). In Furtado et al. (2012), 56.4% of 25 patients were with Fitzpatrick skin type II, 68.2% were within type III, 47.6% were within the IV Fitzpatrick scale and 27.8% ranged in Fitzpatrick scale V. In Motoki et al., 3.3% of 61 patients ranged within Fitzpatrick scale II, 21.3% were type III, 47.5% were type IV, 26.2% type V and 1.6% were within Fitzpatrick skin type VI. In Lemonas et al., 37.0% out of 46 patients were Fitzpatrick type I-IV, 43.5% were type V and 26.1% were type VI. Therefore in 3 out of 9 studies, patient samples were skewed towards lighter skinned individuals (Fitzpatrick scale I-IV) (Bijlard et al., 2017; Furtado et al., 2012; Motoki et al., 2019).

In relevance to race, gender and age, 22.22% (two of the nine papers) found no correlation between keloid QoL and age, gender, disease duration, or distribution of keloids (visible or nonvisible keloids) (Balci et al., 2009; Bock et al., 2006). However, both studies included patients with hypertrophic scarring and Bock and colleagues stated that females were more likely to seek care for their keloids. Four of the nine papers included in our study observed women having greater negative impact on overall clinical and psychosocial QoL (Bijlard et al., 2017; Furtado et al., 2012; Lemonas et al., 2015; Olaitan, 2009). Of these studies, one study observed no correlation to skin color, age or disease duration (Bijlard et al., 2017) and another study observed no correlation to ethnicity or distribution of keloids (Lemonas et al., 2015). One study observed that men with keloids who rank higher in the body dysmorphic symptom scale suffer

from less self-esteem (Motoki et al., 2019). One paper did not mention any interaction with race, gender or age, but mentioned these factors as important indicators for assessment in future QoL studies (Furtado et al., 2012). No studies mention the intersectional interaction between keloids and race within marginalized identities on keloid QoL.

DISCUSSION

When analyzing pilot data for a QoL survey of keloid patients participating in a genetics study we noticed that the few existing publications investigating the impact of keloids on the quality of life take different approaches and analytical parameters. These preceding QoL studies prompted a further analysis of the QoL impact of keloids in marginalized populations and a comprehensive literature review to better understand the relationship between keloid disease on gender, race and age within the context of health disparities and intersecting marginalized identities.

Bock et al. (2006), was the first published research study to assess for QoL impact in keloid patients (Bock et al., 2006). This study aimed to analyze the QoL impact of keloids (and hypertrophic scars) on patients and confirm the QoL impact of keloids comparable to other skin diseases. Conducted in the Department of Dermatology at the University of Kiel, with 100 outpatients (34:66 Male:Female ratio), patients had a median duration of keloids of 7.2 years and with keloid localization on the trunk. Bock et al. formulated their own questionnaire, which was based on the *Experience with Skin Complaints* questionnaire. Since then, new questionnaires have been implemented to further assess how keloids impact QoL in clinical and psychosocial parameters. While most questionnaires and QoL measures are more tailored to include a wider scope of view, specifically in psychosocial parameters, the small portfolio of keloid QoL studies suggests that more work needs to be done to understand the social impact of keloids especially on marginalized and underserved populations.

In this study, we observed that all papers assessing QoL impact find the clinical and psychosocial QoL impact of keloids to be similar to other chronic cutaneous diseases. All QoL studies report pain and itch as the highest clinical burden, which leads to significant psychological impairment and negatively impacts social functioning. Results from 8 of the 10 studies included in this study support the correlation between the clinical

and psychosocial impact in keloid patients, which corroborates with other current literature.

We also detected several conflicting findings on the QoL impact of keloids and its interaction with race, gender, age, disease duration and distribution. This heterogeneity in results may be due to the variability in approaches of QoL questionnaires, the country where the study was conducted and the lack of acknowledgement and representation of darker-skinned (Fitzpatrick score V-VI) patients.

The results of our literature survey, however, does point to a potential interaction between gender and keloids (Bijlard et al., 2017; Furtado et al., 2012; Lemonas et al., 2015; Olaitan, 2009). Those studies that found no correlation with gender and keloid QoL impact had methodological weaknesses and biases such as the inclusion of hypertrophic scar patients in the sample size and the use of non-study specific measures and/or less common questionnaires (Balci et al., 2009; Bock et al., 2006). While race was not specifically addressed in these studies, results from our pilot study and from Lyons et al., 2019 point to a potential differential perception of keloids, which may further enhance the negative QoL impact in those patients. Not identifying intersectionalities in keloid QoL questionnaires may lead to health research disparities in groups that identify with intersecting marginalized identities. We also realize that large numbers of study participants will be needed to achieve statistical significance when multiple intersectionalities are being considered in QoL analyses.

Heterogeneity in results in this systematic review may also be due to cultural differences in the countries where some of these studies were conducted. The framework of our study analyzes health disparities in marginalized identities in the United States. However, racial and gender inequalities exist globally and need to be addressed within the context of each country. To fully understand the quality of life impact of keloids and other skin disorders it is integral to understand the social construction of race and gender, which in turn drives the psychosocial and clinical responses seen in keloid patients.

CONCLUSION

Keloids have a negative impact on the quality of life of most patients. Based on the results of our pilot study and this literature review, keloid QoL studies indicate that health disparities in the U.S., within the context of

marginalized identities in race and gender, may increase the negative impact on keloid patients. These findings emphasize the need for greater clinical research equality by acknowledging intersectional groups in keloid QoL questionnaires, which will improve the accuracy of such studies as well as disease management. Inclusion and acknowledgement of marginalized identities will contribute to reducing bias and generalizability in keloid research findings.

FUTURE DIRECTIONS

Future QoL study questionnaires should be tailored to include gender, race and socioeconomic factors and consider cultural differences in countries where these studies are being conducted to confirm preliminary study results.

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Authorship Contributions

ST and EJR conceptualized the data and literature analysis and wrote the manuscript. ST performed the data analysis and literature survey.

Disclosure of Conflicts of Interest

No conflicts of interest.

FIGURES AND TABLES

Race/ethnicity		Age [Years] Mean / Standard Deviation	Sex
Black	n=17	46 / 14	7 M / 10 F
White	n=4	36 / 9	3 M / 1 F
Latinx	n=1	29	1 F
Asian	n=2	50 / 8	2 F
Pacific Islander	n=3	52 / 11	2 M / 1 F
Other	n=3	30 / 14	2 M / 1 F

TABLE 1: Pilot Study: Clinical and psychosocial impact survey demographics

Race	Sum of Keloids	Location	Avg. Number of Symptoms
Black (n=17)	71 keloids	Torso (n=11), Face (n=7), Arms (n=5), Legs (n=2), Hands/Feet (n=2)	>3 symptoms
White (n=4)	19 keloids	Torso (n=4), Face (n=1), Arms (n=2), Legs (n=1), Hands/Feet (n=0)	>2 symptoms
Latinx (n=1)	5 keloids	Torso (n=1), Face (n=0), Arms (n=0), Legs (n=0), Hands/Feet (n=0)	4 symptoms
Asian (n=2)	7 keloids	Torso (n=2), Face (n=1), Arms (n=0), Legs (n=0), Hands/Feet (n=0)	3 symptoms
Pacific Islander (n=3)	11 keloids	Torso (n=3), Face (n=1), Arms (n=2), Legs (n=1), Hands/Feet (n=1)	>2 symptoms
Other (n=3)	11 keloids	Torso (n=2), Face (n=1), Arms (n=1), Legs (n=0), Hands/Feet (n=0)	>3 symptoms

Symptoms: itching, burning, pain, throbbing and other

TABLE 2: Pilot Study: number, location and symptoms of keloids

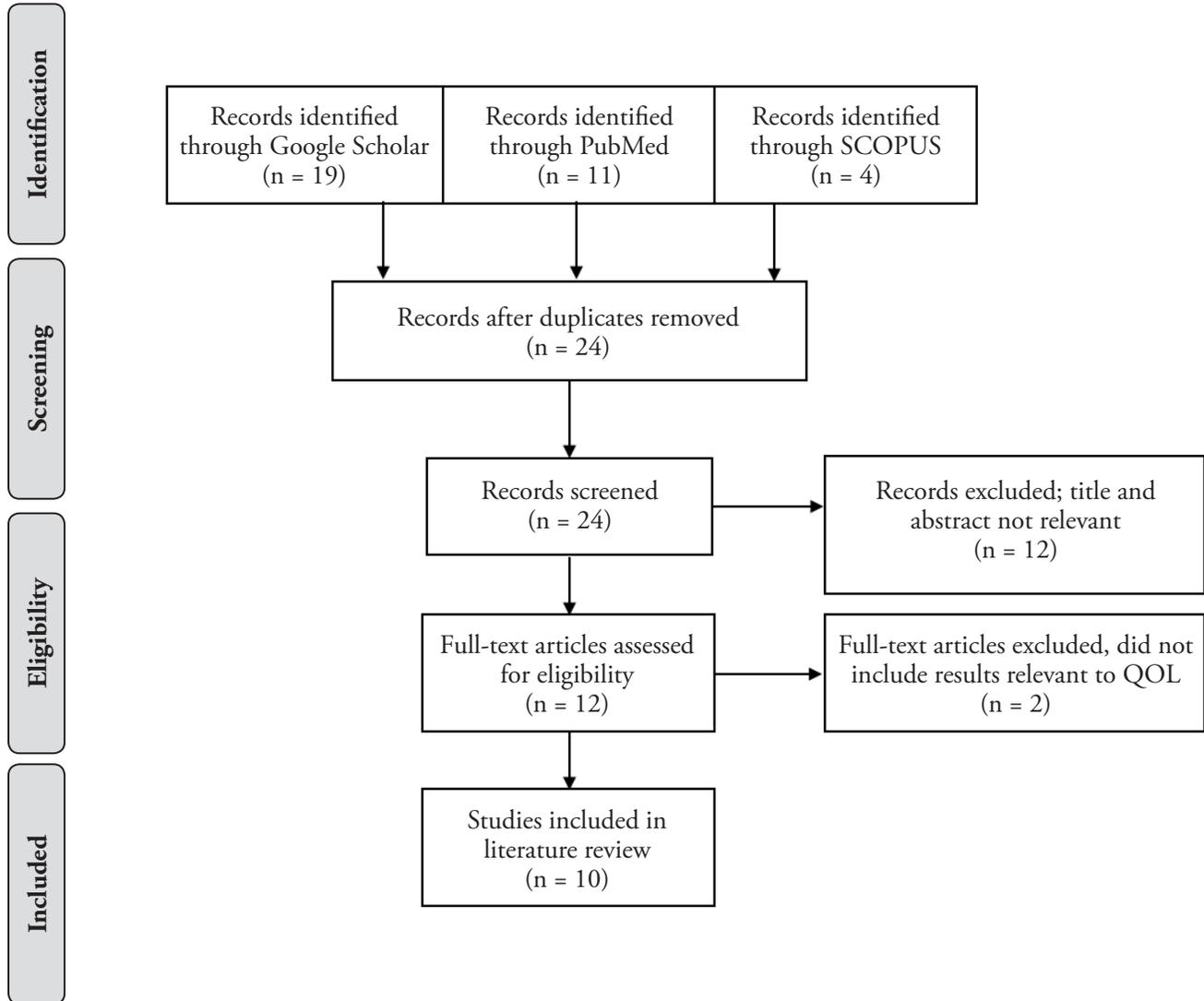


FIGURE 1: PRISMA flow diagram of article inclusion and exclusion

Study	Study design	Setting 1. Clinical setting 2. City, Country	1. Sample size 2. Male:Female ratio 3. Mean (SD) Age (years)	QoL measures, questionnaires
Bock (2006)	To demonstrate, for the first time, the keloid physical and psychosocial impairment on QoL	1. University hospital 2. Kiel, Germany	1. n=100 2. 34:66 3. 36.1 (17.2)	Developed their own questionnaire following the Experience with Skin Complaints questionnaire
Ud-Din and Bayat (2013)	Literature review of keloid treatments to offer more structure to disease management	NA	1. n=54	NA
Kouwenberg (2015)	To determine keloid impact on HRQOL and identify predictors of burden	1. University hospital 2. Not specified	1. n=106	POSAS, Skindex-29, HRQL; SF-36, EQ-5D-5L
Furtado (2009)	To determine what factors influence QoL in keloid patients	1. University hospital 2. São Paulo, Brazil	1. n=102 2. 40:62 3. 27.2 (10.7)	Qualifibro
Olaitan (2009)	To assess the psychosocial impact of keloids in Black African Nigerian populations	1. University hospital 2. Osun State, Nigeria	1. n=131 2. 61:70 3. 34.74 (34)	Not specified
Balci (2008)	To compare the DLQI scores in patients with keloids (and HTS) to DLQI scores of psoriasis patients	1. University hospital 2. Antakya, Turkey	1. n=48* 2. 27:21 3. 29.3 (11.1)	DLQI
Bijlard (2017)	To determine the burden of keloids on HRQOL with a cross-sectional survey study	1. University hospital 2. Rotterdam, The Netherlands	1. n= 106 2. 51:55 3. 38.6 (11.9)	POSAS, Skindex-29, HRQL; SF-36, EQ-5D-5L
Furtado (2012)	To determine if psychological stress increases postoperative recurrence of keloids	1. University hospital 2. São Paulo, Brazil	1. n=25 2. 9:16 3. Range: 30.4, 28.3**	Qualifibro, HADS, GSR, VNS

Motoki (2018)	To determine the impact of keloid on body image	1. University hospital 2. São Paulo, Brazil	1. n=61 2. 61:0 3. Range: 31.29-28.54 ^{***}	BDSS, Rosenberg Self-Esteem Scale
Lemonas (2015)	To determine the combined burdens of pain, physical deformity and psychological distress in keloid patients	1. Keloid clinic at university hospital 2. London, United Kingdom	1. n=46 2. 16:30 3. 32 (range: 22-50)	DLQI, DAS-24, MSF-PQ

* results include patients with hypertrophic scarring, ** results compare non-recurring and recurring keloids, *** results comparing BDSS group ≥ 6 and BDSS < 6

TABLE 3: Studies included in the systematic review: Study design and QoL questionnaires

Physical Impact	Psychological Impact	Social Impact
Presternal localization of keloids ^{1,4}	Psychological impairment ^{1,3,4,6,7,8,9,10}	Hiding scars ^{1,10}
Mobility restriction ^{1,4,8}	Lowered self-esteem ^{1,4,6,9}	Personal relationships ^{1, 6,10}
Pain and itching ^{1,3,4,6,7,8,9,10}	Stigmatization ^{1,4,5,6}	Avoiding public situations ^{1,10}
Ineffective treatments ^{1,2,4,6,8,9,10}	Body dysmorphia ⁹	Social functioning ^{3,5,6,7}
Disease duration ⁴		
Non-visible keloid ^{4,10}		
Visible keloid ^{1,6,7}		
Possibility of recurrence ^{6,8}		
Throbbing, sharp, aching, tender ¹⁰		
Scar thickness, stiffness, irregularity ⁷		
Number of keloids ⁷		

1 = Bock (2005); 2 = Ud-Din and Bayat (2013); 3 = Kouwenberg (2015); 4 = Furtado (2009); 5 = Olaitan (2009); 6 = Balci (2008); 7 = Bijlard (2017); 8 = Furtado (2012); 9 = Motoki (2018); 10 = Lemonas (2015)

TABLE 4: Physical, psychological and social impact of keloids on QoL from the literature

REFERENCES

- Bae, J.M., Lee, S.C., Kim, T.H., Yeom, S.D., Shin, J.H., Lee, W.J., Lee, M.H., Lee, A.Y., Kim, K.H., Kim, M.B., *et al.* (2018). Factors affecting quality of life in patients with vitiligo: a nationwide study. *Br J Dermatol* **178**, 238-244.
- Balci, D.D., Inandi, T., Dogramaci, C.A., and Celik, E. (2009). DLQI scores in patients with keloids and hypertrophic scars: a prospective case control study. *Journal der Deutschen Dermatologischen Gesellschaft = Journal of the German Society of Dermatology : JDDG* **7**, 688-692.
- Basra, M.K., Fenech, R., Gatt, R.M., Salek, M.S., and Finlay, A.Y. (2008). The Dermatology Life Quality Index 1994-2007: a comprehensive review of validation data and clinical results. *Br J Dermatol* **159**, 997-1035.
- Bayat, A., Arscott, G., Ollier, W.E., McGrouther, D.A., and Ferguson, M.W. (2005). Keloid disease: clinical relevance of single versus multiple site scars. *Br J Plast Surg* **58**, 28-37.
- Bijlard, E., Kouwenberg, C.A., Timman, R., Hovius, S.E., Busschbach, J.J., and Mureau, M.A. (2017). Burden of Keloid Disease: A Cross-sectional Health-related Quality of Life Assessment. *Acta Derm Venereol* **97**, 225-229.
- Bock, O., Schmid-Ott, G., Malewski, P., and Mrowietz, U. (2006). Quality of life of patients with keloid and hypertrophic scarring. *Arch Dermatol Res* **297**, 433-438.
- Brutschy, S., and Zachary, D. (2014). Marginalized Communities. In *Encyclopedia of Quality of Life and Well-Being Research*, A.C. Michalos, ed. (Dordrecht: Springer Netherlands), pp. 3771-3776.
- Chren, M.M. (2012). The Skindex instruments to measure the effects of skin disease on quality of life. *Dermatol Clin* **30**, 231-236, xiii.
- Conrad, P., and Barker, K.K. (2010). The social construction of illness: key insights and policy implications. *J Health Soc Behav* **51 Suppl**, S67-79.
- Furtado, F., Hochman, B., Farber, P.L., Muller, M.C., Hayashi, L.F., and Ferreira, L.M. (2012). Psychological stress as a risk factor for postoperative keloid recurrence. *J Psychosom Res* **72**, 282-287.
- Furtado, F., Hochman, B., Ferrara, S.F., Dini, G.M., Nunes, J.M., Juliano, Y., and Ferreira, L.M. (2009). What factors affect the quality of life of patients with keloids? *Rev Assoc Med Bras* (1992) **55**, 700-704.
- Gold, M.H., Nestor, M.S., Berman, B., and Goldberg, D. (2020). Assessing keloid recurrence following surgical excision and radiation. *Burns Trauma* **8**, tkaa031.
- Gravlee, C.C. (2009). How race becomes biology: Embodiment of social inequality. *Am J Phys Anthropol* **139**, 47-57.
- Guy, W.M., Pattisapu, P., Ongkasuwan, J., and Brissett, A.E. (2015). Creation of a head and neck Keloid quality of life questionnaire. *Laryngoscope* **125**, 2672-2676.
- Herdman, M., Gudex, C., Lloyd, A., Janssen, M., Kind, P., Parkin, D., Bonsel, G., and Badia, X. (2011). Development and preliminary testing of the new five-level version of EQ-5D (EQ-5D-5L). *Qual Life Res* **20**, 1727-1736.
- Jalali-Farahani, S., Amiri, P., Bakht, S., Shayeghian, Z., Cheraghi, L., and Azizi, F. (2017). Socio-Demographic Determinants of Health-Related Quality of Life in Tehran Lipid and Glucose Study (TLGS). *Int J Endocrinol Metab* **15**, e14548.
- Kouwenberg, C.A.E., Bijlard, E., Timman, R., Hovius, S.E.R., Busschbach, J.J.V., and Mureau, M.A.M. (2015). Emotional Quality of Life Is Severely Affected by Keloid Disease: Pain and Itch Are the Main Determinants of Burden. *Plast Reconstr Surg* **136**, 150-151.
- Langley, R.G., Krueger, G.G., and Griffiths, C.E. (2005). Psoriasis: epidemiology, clinical features, and quality of life. *Ann Rheum Dis* **64 Suppl 2**, ii18-23; discussion ii24-15.
- Lemonas, P., Ahmad, I., Falvey, H., Jiminez, G., and Myers, S. (2015). Keloid Scars: The Hidden Burden of Disease. *Journal of Pigmentary Disorders* **2**, 1-5.
- Leventhal, D., Furr, M., and Reiter, D. (2006). Treatment of keloids and hypertrophic scars: a meta-analysis and review of the literature. *Arch Facial Plast Surg* **8**, 362-368.
- Limmer, E.E., and Glass, D.A., 2nd (2020). A Review of Current Keloid Management: Mainstay Monotherapies and Emerging Approaches. *Dermatol Ther (Heidelb)* **10**, 931-948.
- Lyons, A.B., Peacock, A., Braunberger, T.L., Viola, K.V., and Ozog, D.M. (2019). Disease Severity and Quality of Life Outcome Measurements in Patients With Keloids: A Systematic Review. *Dermatol Surg* **45**, 1477-1483.
- McCall, L. (2005). The Complexity of Intersectionality. *Signs* **30**, 1771-1800.
- Moher, D., Shamseer, L., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., Shekelle, P., and Stewart, L.A. (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic Reviews* **4**, 1.
- Motoki, T.H.C., Isoldi, F.C., Brito, M.J.A., Filho, A.G., and Ferreira, L.M. (2019). Keloid negatively affects body image. *Burns* **45**, 610-614.
- Ogawa, R., Akaishi, S., Kuribayashi, S., and Miyashita, T. (2016). Keloids and Hypertrophic Scars Can Now Be Cured Completely: Recent Progress in Our Understanding of the Pathogenesis of Keloids and Hypertrophic Scars and the Most Promising Current Therapeutic Strategy. *Journal*

- of Nippon Medical School **83**, 46-53.
27. Ogawa, R., Dohi, T., Tosa, M., Aoki, M., and Akaishi, S. (2020). The Latest Strategy for Keloid and Hypertrophic Scar Prevention and Treatment: The Nippon Medical School (NMS) Protocol. *J Nippon Med Sch*.
 28. Olaitan, P.B. (2009). Keloids: assessment of effects and psychosocial-impacts on subjects in a black African population. *Indian journal of dermatology, venereology and leprology* **75**, 368-372.
 29. Olaitan, P.B., Chen, I.P., Norris, J.E., Feinn, R., Oluwatosin, O.M., and Reichenberger, E.J. (2011). Inhibitory Activities of Omega-3 Fatty Acids and Traditional African Remedies on Keloid Fibroblasts. *Wounds* **23**, 97 -106.
 30. Sachdeva, S. (2009). Fitzpatrick skin typing: applications in dermatology. *Indian journal of dermatology, venereology and leprology* **75**, 93-96.
 31. Seifert, O., and Mrowietz, U. (2009). Keloid scarring: bench and bedside. *Arch Dermatol Res* **301**, 259-272.
 32. Seng, J.S., Lopez, W.D., Sperlich, M., Hamama, L., and Reed Meldrum, C.D. (2012). Marginalized identities, discrimination burden, and mental health: empirical exploration of an interpersonal-level approach to modeling intersectionality. *Soc Sci Med* **75**, 2437-2445.
 33. Tan, S., Khumalo, N., and Bayat, A. (2019). Understanding Keloid Pathobiology From a Quasi-Neoplastic Perspective: Less of a Scar and More of a Chronic Inflammatory Disease With Cancer-Like Tendencies. *Front Immunol* **10**, 1810.
 34. Tran, A.T., Feinn, R., and Copes, L.C. (2019). Can keloid lesions be ascribed? Examining the relationship between keloid disorder, perceived psychosocial distress, and serum neuropeptide Y. *Keloid Research* **3**, 1-8.
 35. Ud-Din, S., and Bayat, A. (2013). Strategic management of keloid disease in ethnic skin: a structured approach supported by the emerging literature. *Br J Dermatol* **169 Suppl 3**, 71-81.
 36. Ud-Din, S., and Bayat, A. (2020). Keloid scarring or disease: Unresolved quasi-neoplastic tendencies in the human skin. *Wound Repair Regen* **28**, 422-426.
 37. Vu, M., Li, J., Haardörfer, R., Windle, M., and Berg, C.J. (2019). Mental health and substance use among women and men at the intersections of identities and experiences of discrimination: insights from the intersectionality framework. *BMC Public Health* **19**, 108.
 38. Ware, J.E., Jr. (2000). SF-36 health survey update. *Spine (Phila Pa 1976)* **25**, 3130-3139.
 39. Wong, S.L. (2015). Medically underserved populations: disparities in quality and outcomes. *J Oncol Pract* **11**, 193-194.