


ORIGINAL ARTICLE

Relationship between depression scores and degree of skin perspiration: A novel cross-sectional study

Daniel López-López¹  | Ricardo Becerro-de-Bengoa-Vallejo² | Marta Elena Losa-Iglesias³ | David Rodríguez-Sanz^{2,4} | Patricia Palomo-López⁵ | César Calvo-Lobo⁶

¹Research, Health and Podiatry Unit, Department of Health Sciences, Faculty of Nursing and Podiatry, Universidade da Coruña, Ferrol, Spain

²Facultad de Enfermería, Fisioterapia y Podología, Universidad Complutense de Madrid, Madrid, Spain

³Faculty of Health Sciences, Universidad Rey Juan Carlos, Alcorcón, Spain

⁴Faculty of Sports Sciences, Universidad Europea de Madrid, Villaviciosa de Odón, Madrid, Spain

⁵University Center of Plasencia, Universidad de Extremadura, Plasencia, Spain

⁶Nursing and Physical Therapy Department, Institute of Biomedicine (IBIOMED), Faculty of Health Sciences, Universidad de León, Ponferrada, León, Spain

Correspondence

Patricia Palomo López, Universidad de Extremadura, University Center of Plasencia, Avenida Virgen del Puerto, 2, 10600 Plasencia, Spain.
Email: patibiom@unex.es

Primary hyperhidrosis (PH) is a common pathological condition related to excessive sweating. It may be associated with depression. Therefore, the main aim of this study was to analyse and compare depression scores between subjects without PH (degree-I) and patients with PH (degrees-II, -III, and -IV). The secondary aim was to describe and compare depression scores among subjects with different PH degrees (I—without perceptible perspiration, II—tolerable perspiration, III—hardly tolerable perspiration, and IV—intolerable perspiration). A sample of 100 subjects with a median age of 23.00 ± 6.00 years was recruited from an outpatient medical centre, where medical history data were registered. The degree of PH was determined using the Hyperhidrosis Disease Severity Scale from degrees I (mild) to IV (very severe). The depression scores were analysed using the Beck Depression Inventory (BDI). Statistically significant differences ($P < 0.001$) were observed for higher BDI scores in the patients with PH (degrees II, III, and IV) than in those without PH (degree-I). Kruskal-Wallis tests demonstrated statistically significant differences for BDI scores ($P < 0.001$), with higher values for degree-III with respect to degree-I and degree-IV with respect to degree-I. Patients with a greater degree (especially III/IV) of PH showed higher BDI scores compared with subjects without PH.

KEYWORDS

depression, Eccrine glands, hyperhidrosis, sweat

1 | INTRODUCTION

Primary hyperhidrosis (PH) is a common yet pathological condition of unknown aetiology. It involves excessive sweating caused by dysfunction in normal thermoregulation.^{1,2}

PH, also known as focal hyperhidrosis or idiopathic hyperhidrosis, appears in early infancy and continues into adult life. It affects specific areas of the body, including: (a) the palms of the hands, (b) the soles of the foot, (c) the axillaries, (d) the groin area, (e) the craniofacial region, and (f) the region under the breast.^{3,4}

Currently, the prevalence of PH is estimated to be 2.9%–6.5%, with an increased incidence rate in persons between 25 and 64 years old, regardless of gender.^{5,6} Indeed, PH may be considered a frequent condition that leads to several medical service consultations because patients who suffer from this condition may show various skin alterations, such as maceration, infections, odour, and reported embarrassment as a result of soaking through their clothes.^{7–9} Furthermore, PH may have serious consequences for patients who suffer from this pathology, such as a poor quality of life, emotional disturbances, limitations in physical activities and working life, medical illnesses, and negative social capacity. Nevertheless, other aspects remain unclear despite the existence of substantial scientific literature reviews.^{10–13}

Abbreviations: BDI, Beck Depression Inventory; BMI, body mass index; IR, interquartile range; PH, primary hyperhidrosis; SD, standard deviation

Various researchers have suggested the probability of a relationship between PH and emotional problems. They argue that symptoms of anxiety and stress are the most commonly reported psychological factors in this area.^{14–16}

Based on this, we hypothesised that patients with higher degrees of PH may have higher Beck Depression inventory (BDI) scores. Therefore, the main aim of this study was to analyse and compare the depression scores between subjects without PH (degree I) and patients with PH (degrees II, III, and IV). In addition, the secondary aim of this research was to describe and compare the depression scores among patients with different degrees of PH (I-without perceptible perspiration, II-tolerable perspiration, III-hardly tolerable perspiration, and IV-intolerable perspiration).

2 | MATERIALS AND METHODS

2.1 | Design and sample

This cross-sectional study design was conducted in a private outpatient medical centre from February 1, 2014 to December 30, 2014. The inclusion of study subjects was carried out using a consecutive sampling method with 125 participants. Of these, 100 gave their consent and were registered for this study.

The inclusion criteria applied in this research were as follows: subjects of both genders without and with several degrees of PH aged 18–64 years old. Patients also had to sign the informed consent form. Subjects were excluded because of: (a) endocrine alterations, (b) infectious or autoimmune illnesses, (c) menopause/physiological problems, (d) pregnancy/breastfeeding, (e) neurological disorders, (f) oncological pathologies, (g) the use of medications, and (h) refusal to provide informed consent.

2.2 | Procedure

Participants were first recruited and interviewed about their (a) medical health, (b) family health history, (c) sociodemographic characteristics (age and gender), and (d) other conditions (endocrine alterations, infectious or autoimmune illnesses, menopause/physiological problems, pregnancy/breastfeeding, neurological disorders, oncological pathologies, medications, or various sports activities).

A physician recorded anthropometric data for each subject, including (a) height (m), (b) weight (kg^2), and (c) body mass index ($\text{BMI} = \text{weight}/\text{height}^2$), using Quetelet's equation.¹⁷ All evaluations were measured in an examination room with a humidity of $45\% \pm 10\%$ and a temperature of $24.1^\circ\text{C} \pm 1^\circ\text{C}$.¹⁸

Next, the examiner determined the severity of PH in every participant using the Hyperhidrosis Disease Severity Scale.¹⁹ This tool, which evaluates the degree of symptoms

Key Messages

- we investigated the relationship between depression and skin perspiration
- patients with a greater degree of primary hyperhidrosis had significantly higher Beck Depression Inventory (BDI) scores
- preventive care for patients' skin perspiration is extremely important to improve health

(from I [mild] to IV [very severe]) and negative implications related to PH in the patient's daily activities, is a validated test with a test-retest reliability of $r = 0.82$ ($P < 0.05$).²⁰

Finally, the subjects finished the BDI test, which assessed 21 questions with global scores between 0 and 63 points. The BDI test was divided into four categories: (a) from 0 to 9 scores (no depression), (b) from 10 to 15 scores (medium depression), (c) from 16 to 23 scores (moderate depression), and (d) from 24 to 57 scores (severe depression). This test is an easy and validated instrument for determining and evaluating people with scores for depression.²¹

2.3 | Ethical considerations

The Institutional Research Ethical Committee at Universidade da Coruña, (A Coruña, Spain; application data C.E.I December 18, 2013) validated that our research conformed to the Declaration of Helsinki and that other organisations were preserved. Furthermore, all patients were informed about the procedures used in our study, and they gave consent.

2.4 | Sample size calculation

Sample size calculation was carried out based on the differences between two independent groups using the G*Power 3.1.9.2 software and the BDI scores of a pilot study ($n = 14$), which included two groups (mean \pm SD): seven subjects without perceptible skin perspiration (degree I; 3.78 ± 2.51) and seven subjects with perceptible skin perspiration (degrees I, II, and III; 8.78 ± 6.81). Indeed, a two-tailed hypothesis, an interval confidence of 95%, $\alpha = 5\%$ error probability of 0.01, a statistical power of 80%, $\beta = 20\%$, and an allocation ratio ($N2/N1$) of 1 were used for the sample size calculation. Therefore, a total sample size of 80 subjects (40 for each group) was recruited. In addition, because of the potential loss of 15% of the participants, $n = 92$ subjects were studied. Finally, a sample size of $n = 100$ subjects divided into subject groups without perceptible skin perspiration ($n = 55$) and with perceptible skin perspiration ($n = 45$) was included in the study.

2.5 | Statistical analysis

A statistical analysis was carried out using the software SPSS 22.0 (IBM SPSS Inc., Chicago, Illinois). A 99% confidence interval (CI) and a P -value < 0.01 were considered statistically significant. The Shapiro-Wilk test was used to assess normality, and all variables were considered to be non-parametric data because all P -values were < 0.05 . Second, descriptive data analyses were performed for the total and divided samples. Considering the quantitative data, the median and interquartile range (IR) were used. Regarding the categorical data, frequencies and percentages were reported. Third, a two-group comparison of the quantitative descriptive data and depression scores between subjects without PH as the control group (degree I) and patients with PH as the case group (degrees II, III, and IV) was performed using the non-parametric Mann-Whitney U test. In addition, the comparison of categorical data between both groups was carried out using Fisher's exact test for the body area distribution of perspiration (palms of the hands, soles of the foot, axillaries, groin area, craniofacial region, and under the breast). Fourth, the four-group comparison of the quantitative descriptive data and depression scores among subjects with different skin-sweating degrees (I—without perceptible perspiration, II—tolerable perspiration, III—hardly tolerable perspiration, and IV—intolerable perspiration) was carried out using the Kruskal-Wallis test, complete with the adjusted paired-samples Wilcoxon test. Furthermore, the comparison of the categorical data between the four groups was carried out using the χ^2 test. Box plots were used to illustrate quantitative differences among all groups. In addition, bars graphs were used to illustrate the categorical data among all groups.

3 | RESULTS

3.1 | Comparison of patients with and without PH

Descriptive data and BDI scores between subjects without PH (degree I; $n = 55$) and patients with PH (degrees II, III, and IV; $n = 45$) are shown in Table 1. There were no statistically significant differences for gender distribution ($P = 0.027$), which showed 37 women and 18 men with degree I PH, as well as 20 women and 25 men with degrees

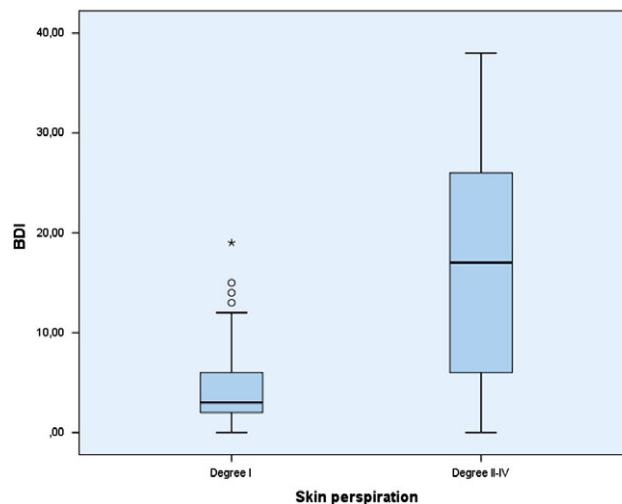


FIGURE 1 Boxplots of BDI scores between subjects without PH (degree I) and patients with PH (degrees II-IV). Abbreviations: BDI, Beck Depression Inventory. In all the analyses, $P < 0.01$ (with a 99% confidence interval) was considered statistically significant

II-IV PH for perspiration body area distribution ($P = 0.061$). As shown in Table 1, statistically significant differences ($P < 0.001$) between both groups were observed for higher weight, BMI, and BDI scores (Figure 1) in patients with PH (degrees II, III, and IV) compared with subjects without PH (degree I). The rest of the comparisons did not indicate any other statistically significant differences ($P > 0.01$).

3.2 | Comparison among patients with different PH degrees

Descriptive data and BDI scores among subjects with different PH degrees (I—without perceptible perspiration, $n = 55$; II—tolerable perspiration, $n = 24$; III—hardly tolerable perspiration, $n = 11$; and IV—intolerable perspiration, $n = 10$) are shown in Table 2. In addition, there were no statistically significant differences with regard to gender distribution ($P = 0.025$), which showed that 37 women and 18 men had degree I PH, 14 women and 10 men had degree II PH, 3 women and 8 men had degree III PH, and 3 women and 7 men had degree IV PH. The perspiration body area distribution was significant ($P = 0.031$). For Table 2, the Kruskal-Wallis tests showed statistically significant

TABLE 1 Descriptive data and BDI scores between subjects without PH (degree I) and patients with PH (degrees II-IV)

	Total Group Median \pm IR (range) $N = 100$	Degree I Median \pm IR (range) $N = 55$	Degrees II-IV Median \pm IR (range) $N = 45$	Mann-Whitney P -value Degree I versus II-IV
Age (y)	23.00 \pm 6.00 (18-49)	23.00 \pm 8.00 (18-49)	24.00 \pm 5.00 (19-46)	0.702
Weight (kg)	65.50 \pm 22.00 (47-120)	60.00 \pm 17.00 (47-110)	76.00 \pm 19.00 (50-120)	<0.001
Height (m)	1.68 \pm 0.14 (1.49-1.90)	1.64 \pm 0.14 (1.52-1.89)	1.73 \pm 0.15 (1.49-1.90)	0.033
BMI (kg/m ²)	23.19 \pm 5.61 (18.78-39.64)	22.06 \pm 4.63 (18.78-32.14)	25.39 \pm 4.81 (19.05-39.64)	<0.001
BDI (kg/m ²)	5.00 \pm 13.00 (00.00-38.00)	3.00 \pm 4.00 (00.00-19.00)	17.00 \pm 21.00 (00.00-38.00)	<0.001

Abbreviations: BDI, Beck Depression Inventory; BMI, body mass index; IR, interquartile range. In all the analyses, $P < 0.01$ (with a 99% confidence interval) was considered statistically significant.

TABLE 2 Descriptive data, BDI depression scores among subjects with different PH (I—without perceptible perspiration; II—tolerable perspiration; III—hardly tolerable perspiration; and IV—intolerable perspiration)

	Degree I Median ± IR (range) N = 55	Degree II Median ± IR (range) N = 24	Degree III Median ± IR (range) N = 11	Degree IV Median ± IR (range) N = 10	Kruskal-Wallis P-value
Age (y)	23.00 ± 8.00 (18-49)	23.50 ± 7.00 (19-46)	24.00 ± 6.00 (21-28)	22.00 ± 3.00 (20-27)	0.502
Weight (kg)	60.00 ± 17.00 (47-110)	77.00 ± 26.00 (50-120)	76.00 ± 13.00 (51-98)	77.50 ± 16.00 (52-87)	0.003
Height (m)	1.64 ± 0.14 (1.52-1.89)	1.70 ± 0.12 (1.49-1.90)	1.73 ± 0.17 (1.60-1.85)	1.71 ± 0.12 (1.53-1.85)	0.156
BMI (kg/m ²)	22.06 ± 4.63 (18.78-32.14)	26.39 ± 6.40 (19.05-39.64)	24.65 ± 2.60 (19.92-29.26)	26.50 ± 2.42 (19.10-27.46)	0.001
BDI (kg/m ²)	3.00 ± 4.00 (00.00-19.00)	8.50 ± 12.25 (00.00-30.00)	23.00 ± 6.00 (19.00-38.00)	28.00 ± 9.50 (02.00-38.00)	<0.001

Abbreviations: BDI, Beck Depression Inventory; BMI, body mass index; SD, standard deviation.

In all the analyses, $P < 0.01$ (with a 99% confidence interval) was considered statistically significant.

differences for weight ($P = 0.003$), BMI ($P = 0.001$), and BDI scores ($P < 0.001$). Indeed, the paired-sample Wilcoxon test showed statistically significant differences for BDI scores (Figure 2) with higher values for degree III PH compared with degree I PH ($P < 0.001$) and for degree IV PH compared with degree I PH ($P < 0.001$). The rest of the comparisons did not indicate any statistically significant differences ($P > 0.01$).

4 | DISCUSSION

PH is common, and clinical guidelines recommend both non-surgical and surgical treatments. However, patients with this condition are not frequently referred for psychological assessment.²²

According to previous studies, PH may be related to a wide range of psychiatric problems. Indeed, anxiety and distress may appear as associated conditions in the clinical records of these patients.^{15,23,24}

The primary aim of this study was to analyse and compare the depression scores between subjects without PH

(degree I) and with PH (degrees II, III, and IV). The findings of our study confirm that participants with PH have significantly higher BDI scores and, therefore, greater levels of depression. This is similar to the results of other researchers who linked depression to PH. These studies demonstrated that the assessment and management of depression are very important because of its negative effects on the course and severity of the disease and the patient's response to treatment.^{16,25}

The secondary aim of this research was to describe and compare the depression scores among subjects with different PH degrees. We showed that participants with PH had higher BDI scores and, therefore, more severe depression regardless of gender. To our knowledge, this is the first study that demonstrates a relationship between the degree and severity of PH and depression.

There are some limitations to our research. First, this investigation was performed at an outpatient medical centre with a relatively small number of patients. Second, a larger and more diverse sample size (including participants from various countries) would improve the strength of the study and help identify more mechanisms involved. Third, there was only one evaluator who recorded the patients' data, which could introduce bias. Finally, our study only reported depression scores without input from a psychologist or a psychiatric diagnosis of depression.

This study highlights the need for further research on the presence and severity of PH and its relationship with the other psychological variables in order to improve the patient's physical, social, and mental health.

5 | CONCLUSIONS

This study suggests that patients with a greater degree (especially degree-III and degree-IV) of PH showed higher BDI scores with respect to subjects without PH.

Financial disclosures

The authors did not receive any sponsor's help in the design, methods, subject recruitment, data collections, analysis, and preparation of paper or have any personal relationships with

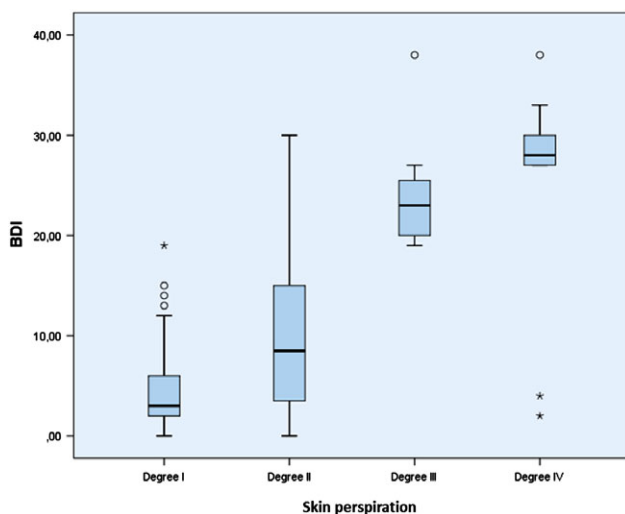


FIGURE 2 Boxplots of BDI scores among subjects with different PH (I—without perceptible perspiration; II—tolerable perspiration; III—hardly tolerable perspiration; and IV—intolerable perspiration). Abbreviations: BDI, Beck Depression Inventory. In all the analyses, $P < 0.01$ (with a 99% confidence interval) was considered statistically significant

other people or organisations that could inappropriately influence (bias) their work.

Author contributions

All authors: concept, design, analyses, interpretation of data, and drafting of manuscript or revising it critically for important intellectual content.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to report.

ACKNOWLEDGEMENTS

We acknowledge all patients who had participate in the research.

ORCID

Daniel López-López  <https://orcid.org/0000-0002-9818-6290>

REFERENCES

- Atkins JL, Butler PEM. Hyperhidrosis: a review of current management. *Plast Reconstr Surg*. 2002;110(1):222-228.
- Hornberger J, Grimes K, Naumann M, et al. Recognition, diagnosis, and treatment of primary focal hyperhidrosis. *J Am Acad Dermatol*. 2004;51(2):274-286. <https://doi.org/10.1016/j.jaad.2003.12.029>.
- López DL, López PP, Ponce ÁM, Gómez RS. Aproximación al manejo de la hiperhidrosis en el pie. *Rev Int Cienc Podol*. April 2013;7(2):89-97. https://doi.org/10.5209/rev_ripc.2013.v7.n2.41740.
- Ramos R, Moya J, Pérez J, et al. Hiperhidrosis primaria: estudio prospectivo de 338 pacientes. *Med Clin (Barc)*. 2003;121(6):201-203. [https://doi.org/10.1016/S0025-7753\(03\)73906-2](https://doi.org/10.1016/S0025-7753(03)73906-2).
- Strutton DR, Kowalski JW, Glaser DA, Stang PE. US prevalence of hyperhidrosis and impact on individuals with axillary hyperhidrosis: results from a national survey. *J Am Acad Dermatol*. 2004;51(2):241-248. <https://doi.org/10.1016/j.jaad.2003.12.040>.
- Shayesteh A, Janlert U, Brulin C, Boman J, Nylander E. Prevalence and characteristics of hyperhidrosis in Sweden: a cross-sectional study in the general population. *Dermatology*. 2016;232(5):586-591. <https://doi.org/10.1159/000448032>.
- Leung AK, Chan PY, Choi MC. Hyperhidrosis. *Int J Dermatol*. 1999;38(8):561-567.
- Solish N, Wang R, Murray CA. Evaluating the patient presenting with hyperhidrosis. *Thorac Surg Clin*. 2008;18(2):133-140. <https://doi.org/10.1016/J.THORSURG.2008.01.002>.
- Leyden JJ, McGinley KJ, Hölzle E, Labows JN, Kligman AM. The microbiology of the human axilla and its relationship to axillary odor. *J Invest Dermatol*. 1981;77(5):413-416.
- Campanati A, Penna L, Guzzo T, et al. Quality-of-life assessment in patients with hyperhidrosis before and after treatment with botulinum toxin: results of an open-label study. *Clin Ther*. 2003;25(1):298-308.
- Amir M, Arish A, Weinstein Y, Pfeffer M, Levy Y. Impairment in quality of life among patients seeking surgery for hyperhidrosis (excessive sweating): preliminary results. *Isr J Psychiatry Relat Sci*. 2000;37(1):25-31.
- Altman RS, Schwartz RA. Emotionally induced hyperhidrosis. *Cutis*. 2002;69(5):336-338.
- Ramos R, Moya J, Morera R, et al. An assessment of anxiety in patients with primary hyperhidrosis before and after endoscopic thoracic sympathectomy. *Eur J Cardiothorac Surg*. 2006;30(2):228-231. <https://doi.org/10.1016/j.ejcts.2006.05.018>.
- Šitum M, Kolić M, Buljan M. Psychodermatology. *Acta Med Croatica*. 2016;70(suppl 1):35-38.
- Schneier FR, Heimberg RG, Liebowitz MR, Blanco C, Gorenstein LA. Social anxiety and functional impairment in patients seeking surgical evaluation for hyperhidrosis. *Compr Psychiatry*. 2012;53(8):1181-1186. <https://doi.org/10.1016/j.comppsy.2012.04.009>.
- Gross KM, Schote AB, Schneider KK, Schulz A, Meyer J. Elevated social stress levels and depressive symptoms in primary hyperhidrosis. *PLoS One*. 2014;9(3):e92412. <https://doi.org/10.1371/journal.pone.0092412>.
- Centers of Disease Control. Body mass index: considerations for practitioners. *CDC*. 2011;4. Available at: <https://www.cdc.gov/obesity/downloads/bmi4forpractitioners.pdf>
- Rodríguez-Sanz D, Losa-Iglesias ME, Becerro de Bengoa-Vallejo R, et al. Skin temperature in youth soccer players with functional equinus and non-equinus condition after running. *J Eur Acad Dermatol Venereol*. March 2018. <https://doi.org/10.1111/jdv.14966>. [Epub ahead of print]
- Solish N, Bertucci V, Dansereau A, et al. A comprehensive approach to the recognition, diagnosis, and severity-based treatment of focal hyperhidrosis: recommendations of the Canadian hyperhidrosis advisory committee. *Dermatol Surg*. 2007;33(8):908-923. <https://doi.org/10.1111/j.1524-4725.2007.33192.x>.
- Kowalski JW, Eadie N, Dagget S, Lai P-Y. Validity and reliability of the hyperhidrosis disease severity scale (HDSS). *J Am Acad Dermatol*. 2004;50(3):P51. <https://doi.org/10.1016/j.jaad.2003.10.202>.
- Alic A, Pranjic N, Selmanovic S, et al. Screening for depression patients in family medicine. *Med Arch (Sarajevo, Bosnia Herzegovina)*. 2014;68(1):37-40.
- International Hyperhidrosis Society. *Treatment Overview*. International Hyperhidrosis Society. Available at: <https://www.sweathelp.org/treatments-hcp/treatment-overview.html>. Published 2018 [Accessed April 12, 2018].
- Davidson JRT, Foa EB, Connor KM, Churchill LE. Hyperhidrosis in social anxiety disorder. *Prog Neuropsychopharmacol Biol Psychiatry*. 2002;26(7-8):1327-1331.
- Ruchinkas RA, Narayan RK, Meagher RJ, Furukawa S. The relationship of psychopathology and hyperhidrosis. *Br J Dermatol*. 2002;147(4):733-735.
- Bahar R, Zhou P, Liu Y, et al. The prevalence of anxiety and depression in patients with or without hyperhidrosis (HH). *J Am Acad Dermatol*. 2016;75(6):1126-1133. <https://doi.org/10.1016/j.jaad.2016.07.001>.

How to cite this article: López-López D, Becerro-de-Bengoa-Vallejo R, Losa-Iglesias ME, Rodríguez-Sanz D, Palomo-López P, Calvo-Lobo C. Relationship between depression scores and degree of skin perspiration: A novel cross-sectional study. *Int Wound J*. 2019;16:139–143. <https://doi.org/10.1111/iwj.13004>