Correlates of Pain Perception: Anxiety and Dissociation

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Abstract. There is a lack of research regarding the link between anxiety and dissociation, on one hand, and pain perception on the other. The existing studies show conflicting results, thus the objective of the present paper is to elucidate the aforementioned relations. All participants (N = 168) completed the State-Trait Anxiety Inventory (STAI Y) and the Dissociative Experience Scale (DES C). The next step consisted of a baseline reading of the respiratory rate (RR) and electrodermal activity (EDA), followed by 80 seconds of pain elicitation during which physiological data was continuously recorded. Both the RR and EDA proved to be reliable indicators for pain perception. No correlation was found between self-reported pain measures and anxiety or dissociation. Overall, there appears to be no connection between anxiety and pain perception, or dissociative experiences and pain perception.
Keywords: pain, state anxiety, trait anxiety, dissociation, skin resistance, respiratory rate.

I. Introduction

The emotional aspects of pain perception, in spite of relatively large scientific literature in the area of pain studies, are far from being completely elucidated. The International Association for the Study of Pain defines pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage" (Merskey, 1986). One such aspect of scientific interest concerns the effect of anxiety on pain perception, whether it refers to catastrophizing, anxiety sensitivity, trait anxiety, state anxiety or fear (Jones, Zachariae, & Arendt-Nielsen, 2003; Tang & Gibson, 2005; Weissman-Fogel, Sprecher, & Pud, 2008; Ocañez, Kathryn McHugh, & Otto, 2010).

DSM IV-TR (2000) defines anxiety as an „apprehensive anticipation of future danger or misfortune accompanied by a feeling of dysphoria or somatic symptoms of tension. The focus of anticipated danger may be in

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ternal or external." (p.820). Anxiety is an ancient mechanism designed to keep us away from harm, and it is conceivable that it alters/would alter pain perception.

Despite significant interest regarding this subject, the relation between anxiety and pain perception remains unclear, with studies generating conflicting results. Both panic disorders and generalized anxiety disorders were shown to be associated with pain related syndromes in the general population (Means-Christensen, Roy-Byrne, Sherbourne, Craske, & Stein, 2008). The same association was found in primary care patients (McWilliams, Goodwin, & Cox, 2004). Beesdo and colleagues (2009) found a stronger association between pain and general anxiety disorders, than between pain and other anxiety disorders, in a community sample. Even though most forms of anxiety were related to pain perception, a 2010 meta-analytic review found a modest link between pain tolerance/threshold and anxiety sensitivity (Ocañez, Kathryn McHugh, & Otto, 2010).

Research on the link between trait anxiety and pain perception in experimental settings is at best modest and reveals conflicting results, with existing evidence for both the presence (James & Hardardottir, 2002) and the absence (Tang & Gibson, 2005) of a sensitising effect of anxiety on pain perception.

In regard to state anxiety, although widely believed to increase pain sensitivity, there is evidence supporting the contrary (Malow, 1981). Moreover, anxiety is often found in co-occurrence with other psychological phenomena. One such co-occurrence is the one between anxiety and dissociation (Wolfradt & Meyer, 1998). DSM IV-TR (2000) defines dissociation as "a disruption in the usually integrated functions of consciousness, memory, identity, or perception of the environment" (p. 822).

Dissociation is often viewed as a defense mechanism. Hilgard (1977) stated, for example, that highly hypnotizable subjects use dissociation to block information (e.g., pain) from reaching consciousness. Even though one of the most widespread instruments to assess dissociative experiences (DES; Carlson & Putnam, 1993) has an item regarding pain perception, there is a very modest amount of literature on the link between the two in experimental settings.

A strong relation was found between dissociative experiences and chronic pelvic pain (Walker, Katon, Neraas, & Jemelka, 1992; Badura, Reiter, Altmaier, Rhomberg, & Elas, 1997), however, the studies were non-experimental. Another non-experimental study involving 14 participants diagnosed with dissociative disorders (according to DSM III) reported more pain syndromes (abdominal pain, pain in the extremities, joint pain, headaches) in the dissociative group than in the control group (Saxe et. al., 1994). Furthermore, in a design in which electrical stimulation was used to

induce pain and stress in borderline patients, a significant positive correlation was found between dissociation and subjective pain thresholds, as well as the subjective pain threshold and aversive arousal (Ludäscher et. al., 2007). Another study involving 41 healthy participants, using a manual algometer, found that the participants with high DES scores had higher pain thresholds than the participants with low DES scores (Ağargün, Tekeoğlu, Kara, Adak, & Ercan, 1998).

The use of skin resistance for pain measurement was employed decades ago (Andrews, 1943). Since then, skin resistance has been used as a biofeedback tool, an instrument for detecting human emotion and a mean to detect deception (DeTurck & Miller, 1985; Nagai, Goldstein, Fenwick, & Trimble, 2004; Lee, et al., 2006). Galvanic skin resistance is also widely used in medical research, including studies regarding pain perception (Weisenberg, Schwarzwald, & Tepper, 1996; Weisenberg, Raz, & Hener, 1998; Al Absi & Rokke, 1991). Although there is less research on the relationship between pain and breathing than on the subject of pain and electrodermal response, there is sufficient evidence that pain alters breathing, increasing ventilation (Molke, Borgbjerg, Nielsen, & Franks, 1996; Sarton, 1997; Nishino, Shimoyama, Ide, & Isono, 1999; Wilhelm, Gevirtz, & Roth, 2001).

The main goal of our study was to explore the relationships between anxiety (state and trait), dissociation and pain perception. More specifically, we aimed to help find an answer to an already old question: Does or doesn't anxiety and dissociation foster the perception of pain?

II. Method

Participants

One hundred and eighty undergraduate and postgraduate psychology students participated in the study in exchange for course credits. After inspecting for missing cases and outliers, we excluded data from 12 participants; consequently, the final sample consisted of 168 participants, all of them being clinically fit for the study's procedure. The mean age was 22 years (SD = 2.11), with 94.6% of them female.

The exclusion criteria referred to any chronic pain syndromes, any preexisting psychiatric diagnosis and any pain medication taken 48 hours prior to the study. Meeting any of the aforementioned criteria constituted sufficient ground for exclusion.

Instruments

State-Trait Anxiety Inventory version Y (STAI Y), adapted for the Romanian population (Pitariu & Pleașă, 2007), is the revised version of the STAI inventory (Spielberger, Gorsuch, & Lushene, 1970). The measure consists of 40 items measured on a 4-point Likert scale (0= *none*; 4= *very much*), divided in two different sections, state (STAI Y1) and trait (STAI Y2) anxiety. The Cronbach's α index for the present sample is high, both for state and trait anxiety (STAI Y1- State, α = .92; STAI Y2- Trait, α=.93).

Dissociative Experience Scale version C (DES C; Wright & Loftus, 1999) is the form of DES II (Carlson & Putnam, 1993) adapted for the nonclinical population. The scale is based on 28 items that measure, on an 11-point response scale, individuals' dissociative experiences. The measure was translated into Romanian and translated back into English by two different experts; inconsistencies were solved by discussion. The Cronbach's α index for the present sample is high (α = .91).

Numerical Rating Scale Pain intensity was verbally rated on an 11-point scale (0 = *no pain*; 10 = *unbearable pain*). The scale was adapted from Williamson & Hoggart (2005). This rating option was chosen due to the fact that the participants could not write as one hand was in the pain stimulator; the other hand was connected to the EDA sensors. For all the participants, pain intensity was measured at 20 second intervals, over an 80 second period, thus the participants responded four times, once every 20 seconds. The results from all the four measures were averaged in a single indicator.

Physiological measure

Lafayette LX4000 computer polygraph system (Lafayette Instrument Company) was used in order to monitor the respiratory rate and electrodermal activity (skin resistance).

The technical description includes: for skin resistance, 10 μA, 0 to 4 VDC current applied to the skin, a range of 10 Kohms to 2.0 Mohms, and isolation 1500 V RMS; for RR, chest assembly, Pneumograph, +/-80 mmHG.

The data was recorded and analysed with the aid of Lafayette Polygraph System software (version 11.1.5, Lafayette Instrument Company). The EDA sensors record electrical resistance in Ohms. The results were then averaged by the software according to the recorded time span. For RR, the software generates a cycle per minute result, which represents the number of respiratory cycles (inhale + exhale) divided by recorded time (in minutes).

Procedure and apparatus

After signing the informed consent, a detailed history (assessing present and past medical conditions, including any psychiatric diagnosis and medication taken in the last two weeks) was noted, followed by the completion of the STAI Y and DES C questionnaires. Immediately after completing the self-report measures, the physiological sensors were attached, followed by a 3 minute baseline measurement of the EDA (skin resistance) and RR (respiratory rate). This procedure assured the baseline values for the aforementioned indicators. After this, the 80 second pain stimulation period followed, during which EDA and RR were measured. The participants reported pain ratings at 20 second intervals. The 80 second interval was set according to previous testing, where it would not cause tissue damage (due to ischemia) but still produced a sufficient amount of pain. The means were calculated for EDA and RR for both the baseline and pain stimulation.

After the completion of the whole study, all participants were debriefed.

An adapted Forgione–Barber stimulator (Forgione & Barber, 1971) was used in order to produce a painful stimulus. The apparatus is equipped with a metal bar in the shape of a blunt knife blade. The subject inserted the left index finger into the apparatus and the assembly applied an 890g weight on the pulp of the finger. The procedure was set for 80 seconds for all participants. The mean pain value for the studied sample was M = 4.96 (SD = 2.32).

III. Results

Preliminary analysis

In order to test if the physiological parameters accurately reflected the induced pain reaction, we compared the data measured during the intervention (i.e., pain stimulation) with the baseline data. Paired sample T tests revealed a significant modification in skin resistance, $t(167) = 15.79$, $p < .001$, $d = .62$. More precisely, comparative to baseline (M = 180.64, SD = 62.20), during the pain stimulation EDA levels decreased (M = 140.59, SD = 42.05). In what concerns the other parameter, pain induction significantly increased RR (M=18.50, SD=2.98), compared to baseline (M = 16.07, SD = 3.04), ($t(167) = -12.97$, $p < .001$, $d = .80$). The results support the use of EDA and RR as pain indicators.

Associations between trait and state anxiety, dissociation and pain indicators

As it can be seen in Table 1, the pattern of correlations reflects orthogonal relationships between self-reported pain, EDA and RR. Furthermore, the associations between state anxiety (STAI Y1), trait anxiety (STAI Y2) and dissociation (DES C), on the one hand, and self-reported pain, EDA and RR, on the other, are almost non-existent. More specifically, only the two measures of anxiety are correlated with RR, measured both at baseline and during pain induction. STAI Y1 shares 2.8% of common variance with RR baseline levels (r = .17, p = .029, two-tailed) and 4.7% of variance with RR measured during pain induction (r = .22, p = .005, two-tailed). The relationships between STAI Y2 and RR measures, reflect similar results, 3.4% of shared variance with baseline RR (r = .18, p = .017, two-tailed) and 4.4% with RR during pain induction (r = .21, p = .006, two-tailed). Table 1 depicts the pattern of correlations between all the study variables.

As it can be observed in the aforementioned data, the correlation between anxiety (both trait and state) and RR, increased from baseline to manipulation (pain induction). In order to understand the nature of the magnitude intensification (if the revealed effect could be due to the pain induction), we compared the correlation coefficients obtained in the two measurement moments. In order to do that, we applied Steiger's Z formula, based on Meng, Rosenthal, and Rubin's (1992) recommendations for comparisons of correlated correlations. There was no significant difference between the correlation of STAI Y1 with baseline RR and the correlation with RR during pain induction (Z = -.799, *ns.*). In a similar manner, the correlation of STAI Y2 with baseline RR was not significantly different from the correlation with RR measured during the pain induction procedure (Z = -.441, *ns.*). Neither of the two sets of compared results reached at least the critical value Z = 1.65 for $p < .05$ (one-tailed) (Meng et al., 1992).

Variables	*Mean*	*SD*	*1.*	*2.*	*3.*	*4.*	*5.*	*6.*	*7.*
1. STAI 1	36.51	11.09	1						
2. STAI 2	39.97	9.73	.67**	1					
3. DES	2.31	1.20	.24**	.42**	1				
4. Pain	4.96	2.32	.03	.07	-.15	1			
5. EDA1	180.64	62.20	.03	.01	-.01	-.02	1		
6. EDA2	140.59	42.05	.01	.02	-.06	-.04	.87**		
7. RR1	16.08	3.04	.17*	.18*	.10	-.07	.00	.01	1
8. RR2	18.50	2.98	.22**	.21**	.09	.00	.04	.04	.68**

Table 1. Means, standard deviations and zero-order correlations among study variables

Note. *N* = 168. STAI 1 = state anxiety; STAI 2 = trait anxiety; DES = Dissociative Experience Scale; Pain = self-reported pain; EDA1 = electrodermal activity (skin resistance) at baseline; EDA2 = electrodermal activity during pain induction; RR1 = breathing rate at baseline; RR2 = breathing rate during pain induction.

*p < .05; **p < .01

V. Discussion

The present study was conducted in order to explore the relations between anxiety (state and trait), dissociation and pain perception. From the perspective of self-reported pain measures, no significant results were found, thus indicating a lack of relation between anxiety and self-reported pain. The lack of correlation between trait anxiety and self-reported measures of pain is in disagreement with James and Hardardottir's (2002) study, which found a sensitizing effect of anxiety on pain perception, although a study conducted by Tang and Gibson (2005), found no such effect. The lack of association could also be a result of the methodological vulnerability of the self-reported measures, with existing scientific debate on the subject (Stinson, Kavanagh, Yamada, Gill, & Stevens, 2006). On the other hand, given that the skin resistance results revealed a similar pattern, it is plausible that no such relation exists (anxiety and pain perception).

The results of the present study support the use of EDA and RR as pain indicators, with significant differences observed between the baseline and the pain stimulation condition.

Both state and trait anxiety showed significant correlations with RR measured at both moments. Although the correlation with RR during the pain stimulation apparently increased in magnitude, the comparison between the correlation coefficients revealed no significant difference. Thus, it is possible that the present correlation could be unrelated to pain. More precisely, the more anxious an individual is, the higher his/her respiratory rate will be, therefore anxiety does not influence RR only during pain

stimulation but in any given circumstance. The results of the statistical analysis support this explication.

A possible explanation for these present results is related to the relevance of anxiety and the orientation of attention. There is evidence that the relevance of anxiety (anxiety regarding the felt pain versus anxiety regarding something else that has nothing to do with the felt pain) is an important factor in pain perception (Al Absi & Rokke, 1991). Also, there is evidence that the orientation of attention (towards or away from the pain) is an essential factor in pain perception (Arntz, Dreessen, & Merckelbach, 1991). In this study there was no manipulation or control of the two factors mentioned above. If indeed those factors, and not anxiety, modify pain perceptions, it is possible that they were not triggered, thus the effect did not appear.

No significant relation was found between the dissociative experiences (DES C) and pain measures (neither from the perspective of self-reported pain measurements nor from the perspective of the physiological recordings). Thus, according to this study, there seems to be no relation between the two phenomena. The only study found to resemble the present one revealed opposite results showing that the participants with high DES scores had significantly higher pain thresholds than the participants with low DES scores (Ağargün, Tekeoğlu, Kara, Adak, & Ercan, 1998).

Also, even though no relation was found between the DES C scores and pain, future studies should address state dissociation, since the DES C refers to past dissociative experiences and the current results cannot be generalized to actual state dissociation. Since there is an ongoing debate regarding the meaning of the term and the types of dissociation (Varga, Dafinoiu, Ile, Bredicean, & Răduț, 2013), replicating this study with a different conceptualization of dissociation is strongly recommended.

However, it is possible that the results of the present study may not be relevant in the case of intense pain. For instance, it is possible that the amount of pain produced in the present study may not be enough to trigger dissociative defenses. Thus it is conceivable that the participants did not actually feel a sufficient amount of pain to trigger the expected correlations. Of course, with the study replication using intense pain, there are also ethical concerns to be considered. In the present study, the induced pain was moderate, and the participants were informed that they could quit the study at any given moment, thus the risk of trauma was minimal.

The present study also has several limitations. First of all, the study design (correlational) made it impossible to formulate causal inferences. A future experimental approach is strongly desirable. Additionally, the vast

majority of the subjects were young females, therefore reducing the results' generalizability.

Despite the fact that both the scientific literature and the present study certify the use of EDA and RR as reliable pain indicators, a study using a control group has not been carried out.

Conclusions

In the implementation of a multi-method approach for pain measurement, only breathing revealed a significant relation with two of the studied constructs (i.e., state and trait anxiety), but this relation appeared, not only for the data recorded during pain elicitation but was also present at the baseline, with no statistically significant difference between the two coefficients. Between the other two pain indicators (i.e., electrodermal activity and self-reported pain) as well as state anxiety, trait anxiety and dissociative experiences, no significant associations were found.

We want to point out that the mismatches between different previous data might be due to the existence of more mechanisms underlying pain processing and perception rather than the actual disagreement in measurement procedures. We strongly endorse the need for future studies aimed at understanding the psychological mechanism of pain perception.

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Reference List

Ağargün, M. Y., Tekeoğlu, I., Kara, H., Adak, B., & Ercan, M. (1998). Hypnotizability, pain threshold, and dissociative experiences. *Biological psychiatry*, 44(1), 69-71.

Al Absi, M., & Rokke, P. D. (1991). Can anxiety help us tolerate pain?. *Pain,*46(1), 43-51.

American Psychiatric Association (2000). Diagnostic and statistical manual of mental disorders (4th ed., revised). Washington, DC.

Andrews, H. L. (1943). Skin resistance changes and measurements of pain threshold. *Journal of Clinical Investigation*, 22(4), 517.

Arntz, A., Dreessen, L., & Merckelbach, H. (1991). Attention, not anxiety, influences pain. *Behaviour research and therapy*, 29(1), 41-50.

Badura, A. S., Reiter, R. C., Altmaier, E. M., Rhomberg, A., & Elas, D. (1997). Dissociation, somatization, substance abuse, and coping in women with chronic pelvic pain. *Obstetrics & Gynecology*, 90(3), 405-410.

Beesdo, K., Hoyer, J., Jacobi, F., Low, N. C., Höfler, M., & Wittchen, H. U. (2009). Association between generalized anxiety levels and pain in a community

sample: evidence for diagnostic specificity. *Journal of anxiety disorders*, 23(5), 684-693.

DeTurck, M. A., & Miller, G. R. (1985). Deception and arousal: Isolating the behavioral correlates of deception. *Human Communication Research*, 12(2), 181-201.

Carlson, E. B., & Putnam, F. W. (1993). An update on the dissociative experiences scale. *Dissociation: Progress in the Dissociative Disorders*, 6(1), 16-27.

Forgione, A. G., & Barber, T. X. (1971). A strain gauge pain stimulator. *Psychophysiology*, 8(1), 102-106.

Hilgard, E. R. (1977). Divided consciousness: Multiple controls in human thought and action. New York: Wiley.

Horowitz, J. D., & Telch, M. J. (2007). Dissociation and pain perception: An experimental investigation. *Journal of traumatic stress*, 20(4), 597-609.

James, J. E., & Hardardottir, D. (2002). Influence of attention focus and trait anxiety on tolerance of acute pain. *British journal of health psychology*, 7(2), 149-162.

Jones, A., Zachariae, R., & Arendt-Nielsen, L. (2003). Dispositional anxiety and the experience of pain: gender-specific effects. *European Journal of Pain*, 7(5), 387-395.

Lee, C., Yoo, S. K., Park, Y., Kim, N., Jeong, K., & Lee, B. (2006, January). Using neural network to recognize human emotions from heart rate variability and skin resistance. In *Engineering in Medicine and Biology Society, 2005. IEEE-EMBS 2005. 27th Annual International Conference of the* (pp. 5523-5525). IEEE.

Ludäscher, P., Bohus, M., Lieb, K., Philipsen, A., Jochims, A., & Schmahl, C. (2007). Elevated pain thresholds correlate with dissociation and aversive arousal in patients with borderline personality disorder. *Psychiatry research*, 149(1), 291-296.

Malow, R. M. (1981). The effects of induced anxiety on pain perception: a signal detection analysis. *Pain*, 11(3), 397-405.

McWilliams, L. A., Goodwin, R. D., & Cox, B. J. (2004). Depression and anxiety associated with three pain conditions: results from a nationally representative sample. *Pain*, 111(1), 77-83.

Means-Christensen, A. J., Roy-Byrne, P. P., Sherbourne, C. D., Craske, M. G., & Stein, M. B. (2008). Relationships among pain, anxiety, and depression in primary care. *Depression and anxiety*, 25(7), 593-600.

Meng, X. I., Rosenthal, R., & Rubin, D. B. (1992). Comparing correlated correlation coefficients. *Psychological Bulletin*, 111(1), 172-175.

Merskey, H. E. (1986). Classification of chronic pain: descriptions of chronic pain syndromes and definitions of pain terms. *Pain*, Vol Suppl 3, 226.

Molke Borgbjerg, F., Nielsen, K., & Franks, J. (1996). Experimental pain stimulates respiration and attenuates morphine-induced respiratory depression: a controlled study in human volunteers. *Pain*, 64(1), 123-128.

Nagai, Y., Goldstein, L. H., Fenwick, P. B., & Trimble, M. R. (2004). Clinical efficacy of galvanic skin response biofeedback training in reducing seizures

in adult epilepsy: a preliminary randomized controlled study. *Epilepsy & Behavior*, 5(2), 216-223.

Nishino, T., Shimoyama, N., Ide, T., & Isono, S. (1999). Experimental pain augments experimental dyspnea, but not vice versa in human volunteers.*Anesthesiology*, 91(6), 1633.

Ocañez, K. L., Kathryn McHugh, R., & Otto, M. W. (2010). A meta-analytic review of the association between anxiety sensitivity and pain. *Depression and anxiety*, 27(8), 760-767.

Pitariu, H., Pleașă, C, trad., adapt. Spilberger, C.D., State-trait anxiety inventory, Synapsis, 2007.

Rhudy, J. L., & Meagher, M. W. (2000). Fear and anxiety: divergent effects on human pain thresholds. *Pain*, 84(1), 65-75.

Sarton, E., Dahan, A., Teppema, L., Berkenbosch, A., van den Elsen, M., & van Kleef, J. (1997). Influence of acute pain induced by activation of cutaneous nociceptors on ventilatory control. *Anesthesiology*, 87(2), 289-296.

Saxe, G. N., Chinman, G., Berkowitz, R., Hall, K., Lieberg, G., Schwartz, J., & Van Der Kolk, B. A. (1994). Somatization in patients with dissociative disorders.*American Journal of Psychiatry*, 151(9), 1329-1334.

Spielberger, C. D., Gorsuch, R. L., & Lushene, R. E. (1970). Manual for the state-trait anxiety inventory.

Stinson, J. N., Kavanagh, T., Yamada, J., Gill, N., & Stevens, B. (2006). Systematic review of the psychometric properties, interpretability and feasibility of self-report pain intensity measures for use in clinical trials in children and adolescents. *Pain*, 125(1-2), 143-157.

Tang, J., & Gibson, S. J. (2005). A psychophysical evaluation of the relationship between trait anxiety, pain perception, and induced state anxiety. *The journal of pain: official journal of the American Pain Society*, *6*(9), 612.

Varga Ș. S., Dafinoiu I., Ile L. I., Bredicean C., Răduț R. O. (2013). The terminological relativism of dissociation: A literature review, *Romanian Journal of Psychiatry*, 15(1), 6-11.

Walker, E. A., Katon, W. J., Neraas, K., & Jemelka, R. P. (1992). Dissociation in women with chronic pelvic pain. *The American journal of psychiatry*, 149(4), 534-537.

Weisenberg, M., Schwarzwald, J., & Tepper, I. (1996). The influence of warning signal timing and cognitive preparation on the aversiveness of cold-pressor pain.*Pain*, 64(2), 379-385.

Weisenberg, M., Raz, T., & Hener, T. (1998). The influence of film-induced mood on pain perception. *Pain*, 76(3), 365-375.

Weissman-Fogel, I., Sprecher, E., & Pud, D. (2008). Effects of catastrophizing on pain perception and pain modulation. *Experimental Brain Research*, 186(1), 79-85.

Wilhelm, F. H., Gevirtz, R., & Roth, W. T. (2001). Respiratory dysregulation in anxiety, functional cardiac, and pain disorders assessment, phenomenology, and treatment. *Behavior Modification*, 25(4), 513-545.

Williamson, A., & Hoggart, B. (2005). Pain: a review of three commonly used pain rating scales. *Journal of clinical nursing*, 14(7), 798-804.