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Ecological aspects of pain in sensory modulation disorder

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ABSTRACT

Background: Sensory Modulation Disorder (SMD) interferes with the daily life participation of otherwise healthy individuals and is characterized by over-, under- or seeking responsiveness to naturally occurring sensory stimuli. Previous laboratory findings indicate pain hyper-sensitivity in SMD individuals suggesting CNS alteration in pain processing and modulation. However, laboratory studies lack ecological validity, and warrant clinical completion in order to elicit a sound understanding of the phenomenon studied. Thus, this study explored the association between sensory modulation and pain in a daily life context in a general population sample.

Methods: Daily life context of pain and sensations were measured in 250 adults (aged 23–40 years; 49.6% males) using 4 self-report questionnaires: *Pain Sensitivity Questionnaire (PSQ)* and *Pain Catastrophizing Scale* (PCS) to evaluate the sensory and cognitive aspects of pain; the *Sensory Responsiveness Questionnaire* (SRQ) to appraise SMD; and the *Short Form – 36 Health Survey, version 2 (SF36)* to assess health related Quality of Life (QoL).

Results: Thirty two individuals (12.8%) were found with over-responsiveness type of SMD, forming the SOR-SMD group. While no group differences (SOR-SMD vs. Non-SMD) were found, low-to-moderate total sample correlations were demonstrated between the SRQ-Aversive sub-scale and i) PSQ total ($r = 0.31$, $p < 0.01$) and sub-scales scores ($r = 0.27$–0.28, $p < 0.01$), as well as ii) PCS total and the sub-scales of Rumination and Helplessness scores ($r = 0.15$, $p < 0.05$). PSQ total and sub-scale scores were more highly correlated with SRQ-Aversive in the SOR-SMD group ($r = 0.57$–0.68, $p = 0.03$–<0.01) compared to Non-SMD group. The *Physical Health – Total* score (but not the *Mental Health – Total*) of the SF36 was lower for the SOR-SMD group ($p = 0.03$), mainly due to the difference in the *Body pain* sub-scale ($p = 0.04$).

Conclusions: Results suggest that SOR-SMD is strongly associated with the sensory aspect of pain but weakly associated with the cognitive aspect. This indicates that SMD co-occurs with daily pain sensitivity, thus reducing QoL, but less with the cognitive-catastrophizing manifestation of pain perception.

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1. Introduction

Sensory Modulation Disorder (SMD), a subtype of sensory processing disorder, is a generalized disorder that affects modulation across single or several sensory systems (Bundy & Murray, 2002; ICDL, 2005; Kimball, 1993; Miller, Anzalone, Lane, Cermak, & Osten, 2007; PDM, 2006; Zero, 2005). There are three sub-types of SMD: (1) sensory seeking or craving in which the individual seeks an unusual amount or type of sensation and seems to have an insatiable craving for sensation (ICDL, 2005; Miller et al., 2007; PDM, 2006; Zero, 2005); (2) sensory under-responsivity, clinically demonstrated by delayed and/or decreased responses to external stimulation (Ahn, Miller, Milberger, & McIntosh, 2004; Bar-Shalita, Vatine, & Parush, 2008; Fisher & Dunn, 1983; ICDL, 2005; Kinnealey, Oliver, & Wilbarger, 1995; Miller et al., 2007; PDM, 2006; Reeves, 2001; Zero, 2005); and (3) sensory over-responsivity (SOR-SMD), a condition in which non-painful stimuli are processed as abnormally irritating, unpleasant (Fisher & Dunn, 1983; ICDL, 2005; Kinnealey et al., 1995; Miller et al., 2007; PDM, 2006; Reynolds & Lane, 2008; Zero, 2005), or painful (Bar Shalita, Vatine, Seltzer, & Parush, 2009; Bar-Shalita, Vatine, Yarnitsky, Parush, & Weissman-Fogel, 2014; Fisher & Dunn, 1983; Reeves, 2001).

Indeed, Bar Shalita, Vatine, et al. (2009) found that subjects with SOR-SMD, demonstrated hyper-sensitivity in response to laboratory quantitative sensory testing (QST) of suprathreshold pain stimuli. The authors found that children and adults with SMD rated these stimuli as more painful compared to control subjects. Moreover, they reported that the lingering sensations were both more intense and longer than those of controls, suggesting alterations in pain processing and modulation (Bar Shalita, Vatine, et al., 2009). These laboratory findings are important evidence of pain perception alterations in SMD subjects. However, despite these people clinically demonstrating extreme hypersensitivity, they are not defined as pain patients, and so are considered to be pain-free subjects.

Pain is a complex multidimensional experience comprised of sensory, affective, and cognitive processes (Moayedi & Davis, 2013). Different aspects of the painful event such as contextual factors, environmental factors, and prior experience, can modulate pain processing and may have different impacts on the different dimensions of pain. Moreover, painful events in real-world situations are not isolated and often occur in conjunction with input from additional sensory modalities. Thus, it is essential to understand pain processing in naturalistic multisensory environments. The usual deliberately restricted laboratory conditions, under which standard well-designed studies are carried out, have a drawback in that they lack 'ecological validity', or generalizability to real life (Rollman, 2005). Thus experimental induced pain in the laboratory, which characterizes population sub-groups such as SMD, is not necessarily valid beyond the laboratory.

Therefore, in this study, we aimed to validate the laboratory pain findings in SMD via ecological assessments by using pain-related questionnaires in the general population. These questionnaires included the Pain Sensitivity Questionnaire (PSQ) and the Pain Catastrophizing Scale (PCS) that make use of typical and common painful events that occur in everyday life, in order to evaluate sensory and cognitive aspects of pain perception. The PSQ was proposed as an alternative tool to experimental pain intensity rating procedures for evaluating pain sensitivity in healthy subjects and chronic pain patients (Ruscheweyh, Marziniak, Stumpenhorst, Reinholz, & Knecht, 2009; Ruscheweyh et al., 2012). Pain catastrophizing (measured on the PCS), is characterized by amplification of feelings about painful situations and constant thoughts about these situations (Meyer, Tschopp, Sprott, & Mannion, 2009), and is described as a cognitive process involving the tendency to exaggerate and misinterpret the threat value of situations (Van Damme, Crombez, Bijttebier, Goubert, & Van Houdenhove, 2002).

While the probability of SMD rises in populations with neurodevelopmental conditions, such as Autism and ADHD (Ben-Sasson et al., 2007; Chang et al., 2014; Parush, Sohmer, Steinberg, & Kaitz, 2007), it is estimated that 5–16% of the typical pediatric population demonstrates SMD (Ahn et al., 2004; Ben-Sasson, Carter, & Briggs-Gowan, 2009; Schaaf, Miller, Seawell, & O'Keefe, 2003). Though occurring in adulthood (Bar-Shalita, Seltzer, Vatine, Yochman, & Parush, 2009; Brown, Tollefson, Dunn, Cromwell, & Filion, 2001; Kinnealey et al., 1995) prevalence of SMD in adults had not yet been reported. SMD subjects experience the environmental stimuli as irritating, aversive, unpleasant and painful that it often interferes with participation in daily life (Bar-Shalita et al., 2008; Dunn, 2007), which may impact their quality of life (QoL). Indeed, lower scores in QoL measures have been documented in children and their families as well as in adults reporting SOR (Carter, Ben-Sasson, & Briggs-Gowan, 2011; Kinnealey, Koenig, & Smith, 2011). However, a better understanding of the association between sensory responsiveness and pain perception in the context of daily living and QoL is warranted. This understanding may yield new research directions aimed at investigating possible therapeutic interventions for SMD individuals based on pain mechanisms.

Thus, this study aims at exploring in an ecological fashion the association between sensory responsiveness, pain perception and QoL in subjects from the general population, with and without SMD. A secondary purpose was to culturally adapt and initially test the Hebrew version of the PSQ.

2. Materials and methods

This research was approved by the review committee at the Hebrew University of Jerusalem, and all participants completed and signed a consent form before enrolling in the study.