

Well-being in Children with Misophonia:
Evidence from the *Sussex Misophonia Scale for Adolescents*

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Author Note

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Abstract

Misophonia is an unusually strong aversion to a specific class of sounds -- most often human bodily sounds such as chewing, crunching, or breathing. A number of studies have emerged in the last 20 years examining misophonia in adults, but little is known about the impact of the condition in children. Here we present the first evidence of significantly poorer well-being profile in children with misophonia (10-14 years). We screened n142 children using our novel diagnostic (the *Sussex Misophonia Scale for Adolescents; SMS-A*). This allowed us to identify the group of children already manifesting misophonia at that age – the first randomly sampled cohort of child misophonics examined to date. Children and their parents also completed a well-being battery, and these data show that children with misophonia have a significantly poorer life-satisfaction, significantly poorer quality of life, and significantly elevated levels of anxiety and obsessive compulsive traits. Together our data suggest the first evidence in random sampling of poorer life outcomes for children with misophonia and a pressing need for greater recognition and therapeutic outlets.

Keywords: Misophonia, Sound-sensitivity, Sensory sensitivity, aversion

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Misophonia is a sound sensitivity condition in which certain classes of sounds trigger unusual negative emotions such as anger, disgust, or anxiety. Typical triggers include everyday sounds such as chewing, crunching, clicking and breathing. These sounds are not particularly loud, and easily ignored by most other people, but are highly aversive to people with misophonia. The condition appears to rest on subtle organisational differences in the brain that likely arise during development, and lead to important variations in sound tolerance - which can impact profoundly on daily life. People with misophonia show increased functional and structural connectivity in regions related to threat, emotion, and salience, (Kumar et al., 2017; Schröder et al., 2019) suggesting that sounds are more salient and emotionally harmful than they might be for most other people. Here we consider the roots of this unusual condition, by seeking evidence of misophonia in children. Our study aims to identify whether the condition can be recognised in young cohorts (10-14 years) using a novel measure, and whether misophonia is associated with demonstrably poorer well-being.

Some studies suggest as many as 19% of the population may have some degree of misophonia (Wu et al., 2014; Zhou et al., 2017) with yet-higher rates in groups with elevated anxiety (Naylor et al., 2020). However, the exact prevalence may still be unknown since it is difficult to draw a line between everyday disliking, and the type of disliking linked to misophonia (e.g., most people dislike messy eating sounds but only misophonics will feel the extreme emotions that make tolerating these sounds almost impossible). It is therefore important to use a robust

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methodology when identifying people with misophonia for research purposes. Although several validated misophonia questionnaires exist for adults (Rinaldi et al., 2021; Wu et al., 2014), there are no validated tests for children. Our review found that child-completed (or indeed parent-completed) assessments of any kind are rare in misophonia, and those that exist are typically ‘add-ons’ to adult diagnostics (e.g., with instructions to substitute “my sound issues” for “my child’s sound issues”). This sometimes create ambiguous items (e.g., *My [→ my child’s] sound issues currently make me unhappy*; Who is unhappy: parent or child?) or require parents to comment on difficult-to-distinguish internal mental states of their children (e.g., *My child feels helpless? Or isolated? Or guilty?*). Therefore, one aim of this study was to validate a novel diagnostic of misophonia in children: our newly devised *Sussex Misophonia Scale for Adolescents* (SMS-A). We describe this briefly below.

Our adolescent misophonia measure is based on an existing scale (Sussex Misophonia Scale; (Rinaldi et al., 2021) recently validated in adults. Importantly, we created this original adult questionnaire in such a way as to be ideally suited to adapting for adolescents, by using psycholinguistic norming data to ensure its language was appropriate not just for adults but also for children (see *Methods*). Additionally, the original adult questionnaire was devised to be time-efficient (e.g., for when testing adults in large cohorts or within a battery of other tests) but this also makes it suitable for the shorter attention spans of younger participants. Finally, the adult questionnaire was specifically written in such a way that a parallel adolescent measure could be created in the future with only the most minimal adaptation (e.g., it would require only a single word change in just four items exchanging *work* for *school*: *I avoid work* → *I avoid school*; see Appendix for full adolescent questionnaire). Hence, our original adult questionnaire was ideally suited to be adapted into an adolescent version, which we have done in the current study. We then administered this questionnaire to a sample of children 10-14 years, to identify those with misophonia, whom we could subsequently examine for well-being.

Any research study -- and indeed any diagnostic -- of misophonia in adolescents would be especially valuable for a number of reasons. Misophonia was named and recognized only recently (Jastreboff & Jastreboff, 2001) and has not yet entered formal diagnostic manuals such as the DSM-V and ICD-11 (American Psychiatric Association, 2013; World Health Organization, 2020). This lack of widespread recognition has partly contributed to the relatively poorer life-outcomes reported by people with misophonia – especially those with more profound aversions. The condition has been linked with poorer well-being in adults, where quality of life declines with increasing misophonia symptoms (Jager et al., 2020) while depressive symptoms increase (Eijsker et al., 2019), and where people with misophonia show higher rates of anxiety and OCD/obsessive symptoms (Cusack et al., 2018). However, almost nothing is known about misophonia in children, even though the condition appears to arise at some point during childhood or adolescence (Rouw & Erfanian, 2018). Moreover, misophonia can worsen with age if left unaddressed, and give rise to coping strategies (e.g., wearing headphones) that could theoretically worsen sensitivity over time (Palumbo et al., 2018). Importantly, young children often cannot advocate for themselves to seek treatment. And even if they do so, a lack of clinical and research understanding means that medical professionals are often unable to provide children with the support they need. Our aim therefore is to demonstrate the presentation of misophonia in children, and to examine its impact on well-being.

To understand the focus of our research on well-being, we must understand that “well-being” is a broad construct (Pollard & Lee, 2003), incorporating different concepts such life satisfaction (Diener, 2000), hedonic well-being (e.g. emotional stability, good mental health), eudaemonic well-being (e.g. positive mental attitude, fulfillment, e.g. Ryff, Lee, & Keyes, 1995), bodily/ health-related well-being (e.g., Erhart et al., 2009), and the psychological/ physical/ social well-being that contributes to health-related quality-of-life (Erhart et al., 2009b; The Whoqol Group,

1998). As we might therefore expect, the literature on childhood well-being is also extremely heterogeneous, focussing on both single well-being concepts, and multi-dimensional ones (Ben-Arieh & Frønes, 2007; Casas, 2019; McLellan & Steward, 2015; Newland et al., 2019; Pollard & Lee, 2003). Importantly however, differences in children's well-being predict inequalities in a number of different ways. For example, lower levels of well-being have been linked to lower educational attainment (Lindeboom, van den Berg, von Hinke Kessler Scholder, & Washbrook, 2010; (Sammons et al., 2008); Morrison Gutman & Vorhaus, 2012), school exclusions (Parry-Langdon et al., 2008), poorer behaviour (Sylva et al., 2008), and lowered life chances (Cornaglia et al., 2015). And well-being is known to be particularly poor in children with sensory differences (e.g., higher rates of anxiety in children with synaesthesia or multi-sensory sensitivities; (Simner et al., 2021; Smees et al., 2021). It is therefore important to understand the well-being profiles of children with misophonia – in areas such as schooling, peer relationships and home life.

In summary, our research aims to understand the well-being of children with misophonia, while validating a novel diagnostic measure for childhood misophonia (our SMS-A). If our misophonia scale successfully identifies a group of children who go on to show significant differences from their peers *in other ways* (i.e., in well-being), we suggest this goes some way towards validating the measure itself. To be clear, an ideal approach to validation might include other measures such as Receiver Operator Characteristic (Mehdi & Ahmadi, 2011), as we used when showing that our adult measure is an “excellent” tool for separating a large group of pre-identified misophonics from a group of pre-identified controls (Rinaldi et al., 2021). In children however, we do not have a “large group of pre-identified misophonics” – for precisely the reasons we are conducting this research. In other words, we have a problem of circularity: the lack of diagnostics and poor recognition for childhood misophonia means there are few or no large cohorts of child misophonics we could use to validate any diagnostic. Therefore, we

instead seek *convergent* validity, showing that children identified as having misophonia by the SMS-A are also those showing broader well-being deficits, compared to their peers. We will therefore screen a cohort of children for misophonia using the SMS-A and then explore the well-being of those identified as having misophonia (using criteria described in our *Methods* below).

Methods

Participants

We tested 275 participants, comprising 142 children and adolescents aged 10-14 years (Mean 11.72 SD 1.12; 65 female, 77 male), along with 133 of their parents (113 female, 19 male, 1 prefer not to say) whose children had a mean age 11.73 (SD 1.14; 64 female, 69 male). (There were nine more children than adults since nine families ended testing after the child-measures but before the adult-measures. We therefore included these families in our analyses of child-measure only.)

Our participants were drawn from the MULTISENSE project, a large-scale screening study focussing on multiple aspects of childhood development (e.g., multisensory processing, creativity, attainment; e.g., Rinaldi, Smees, Carmichael, & Simner, 2019; Simner et al., in prep.; Simner, Smees, Rinaldi, & Carmichael, 2019). The inclusion criteria for the MULTISENSE project was to be within Years 2-5 of 22 Infant and Primary schools across East and West Sussex in the south of England in 2016, where uptake for the study was 99% and represented over three thousand children in the initial recruitment wave. As an indicator of affluence/poverty (Taylor, 2018) the mean school-level *Free School Meal* percentage for this cohort was 13.44 %, where the national average from the same year is 14.5%, and our schools ranged in FSM status from

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0.7% to 38.1%. The 142 children in our current study were those whose parents had agreed to stay in touch for future screening, and they were tested for the current study four years after initial recruitment. Testing took place between November 2020 and March 2021, and (parent) participants were entered into a £100 prize draw.

Materials and Procedure

Participants completed our study remotely, using our in-house web application (www.misophonia-hub.org). Parent participants were sent a URL via email to take part, and this led them directly into our testing page. The study began with a request for demographic information on age, gender etc. Participants then began our testing battery, which included the five measures below (alongside other tests to be reported elsewhere). The first four measures were completed by children, taking approximately 20 minutes, and the final measure was completed by parents, taking 5 minutes.

SMS-A: Sussex Misophonia Scale for Adolescents. This in-house questionnaire presents 48 known misophonia triggers in Part 1 (see Table 1), and then 39 Likert-type statements in Part 2. In Part 1, participants are told that the questionnaire concerned things they hear and see, and they were asked: *Have you always hated these things? Or don't you mind them?* Using check boxes, participants respond Yes/No to eight broad categories (e.g., *I hate... the sound of people eating*; see Table 1). If all eight responses were No, participants proceeded to Part 2. But for any *Yes* response, this revealed a full list of triggers within that category. For example, if participants responded *Yes* to *I hate the sound of people eating*, this revealed check boxes for eight types of eating-sound (*crunchy foods (e.g. apples); crispy snacks; chewing; lip smacking; swallowing; slurping (a drink); wet mouth sounds (e.g., yoghurt); other eating sound*; see Table 1). Across our eight categories, we presented a total of 48 trigger items, although our

conditional logic allowed us to ask this in a time-efficient way. These 48 items were drawn from a detailed literature search, representing triggers identified for misophonia at the time of testing (see (Rinaldi et al., 2021)).

Table 1. *Triggers for misophonia, and their superordinate category.*

No.	We're going to ask you about things you see and hear every day. Have you always hated these things? Or don't you mind them? I hate...	Which do you hate hearing (<i>or seeing, for category 7</i>)? Tick all that apply.
1	the sound of people eating	crunchy foods (e.g. apples); crispy snacks; chewing; lip smacking; swallowing; slurping (a drink); wet mouth sounds (e.g., yoghurt); other
2	the sound of repetitive tapping	pen clicking; foot tapping/ foot on floor; repetitive barking; tapping pen/ pencil; tapping finger; typing on a computer; other
3	the sound of rustling	rustling paper; rustling plastic; other
4	throat sounds	throat clearing; hiccups; humming; other
5	sounds people make through their mouth and nose	breathing; snorting (e.g., when people laugh); nose sniffing; coughing; snoring; whistling; sneezing; burping; other
6	some voice sounds	certain accents; some people's voices; certain letter sounds; certain vowels; certain consonants; other
7	repetitive visual movements	repetitive leg rocking; foot shuffling; people rocking back and forth on their chair; other
8	some background sounds (e.g., fridge humming)	clock ticking; car engines; refrigerator humming; dishwasher; washing machine/ dryer; fan; other

Categories are shown first; sub-set items are revealed in the event of a positive response. Note that seven out of eight trigger-categories are for sounds, while one category is non-auditory because people with misophonia can also be triggered by repetitive visual movements such as leg-swaying.

In Part 2, participants were shown 39 statements, with the question: How often do these things happen to you? Responses were given on a 5-point scale (*Never, Rarely, Sometimes, Often, Always*). Examples include: *Hatred of some sounds make me feel lonely* (Item 18); *I don't do well at school because of distractions from sounds* (Item 12); *I want to get pay-back on people who make certain sounds* (Item 37); *I cover my ears to block out certain sounds* (Item 28); and

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Sounds often cause me physical pain (Item 9). We point out that questions related to pain are suggestive of the condition of hyperacusis (i.e., pain or discomfort, especially from loud sounds) rather than misophonia itself. However, hyperacusis is co-morbid with misophonia (Jastreboff & Jastreboff, 2014; Rinaldi et al., 2021), and these questions correlate highly with all others (Rinaldi et al., 2021). They are included here because they also allow clinicians to observe the possible need for hyperacusis screening¹.

This questionnaire was adapted from an almost identical version for adults, with only a single-word difference, changing *work* to *school* in four items (Q12, Q14, Q22, Q31; see Appendix). This was possible since the original adult version had been created in such a way as to be ideally suited to adapting for adolescents. Specifically, we had used psycholinguistic norming data to ensure its language was appropriate not just for adults but also for children. We conducted a linguistic analysis of its vocabulary using age of acquisition norms (Bird et al., 2001; Gilhooly & Logie, 1980) retrieved via the N-Watch psycholinguistics tool (Davis, 2005). This analysis showed that the vocabulary within this test makes it appropriate for adolescents in our study, having a mean age-of-acquisition of 3 years 9 months, with an upper age of 8 years 2 months (based on n122 of its 173 words, which were retrievable from N-Watch).

In total, Parts 1 and 2 contained 109 items, with 48 items revealed conditionally, meaning our questionnaire took only 5-10 minutes to complete. Receiver Operator Characteristic show this

¹ In the adult version of this questionnaire, a factor analyses by Rinaldi et al. (2021) revealed 5 factors, seen respectively in the five examples shown here, and these factors were: Feelings and Isolation (Items 2, 3, 4, 5, 10, 11, 16, 17, 18, 23, 24, 26, 27, 30, 32, 38); Life Consequences (i.e., impact on work and friendships; Items 12, 13, 14, 21, 22, 31); Intersocial Reactivity (Items 8, 15, 35, 36, 37); Avoidance and Repulsion (Items 1, 7, 20, 28, 29, 33, 34, 39); and Pain (suggestive of hyperacusis; Items 6, 9, 19, 25). This factor analysis had reduced an original set of 53 items down to the 39 used here in the final version. Internal reliability of all factors was very high with Cronbach's alpha estimates of .98, .94, .91, .92 and .95 for factors 1-5 respectively. However, we will not explore factor structure in adolescents because our sample size does not support this approach.

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questionnaire to be an excellent measure for identifying misophonia in adults (Rinaldi et al., 2021) and the current study will add validation for the adolescent version.

Very Short Wellbeing Questionnaire for Children (VSWQ-C) (Smees et al., 2020). The VSWQ-C questionnaire captures health-related quality-of-life in a brief measure for children aged 6+ years. Its four positively-worded questions are *Have you got on well in class? Have you got on well at home? Have you got on well with friends?* and *Has your body felt well?* Children complete the questionnaire by rating statements on a 5-point Likert scale: *Never, Hardly ever, Sometimes, Mostly, or Always*. The VSWQ-C was developed from a consideration of the Health-Related Quality-of-life literature (e.g., Ravens-Sieberer & Kidscreen Group Europe, 2006; Solans et al., 2008) and designed for fast administration, while covering key levels of well-being (*home life, school life, friends and health*). A recent validation on more than 1500 children (Smees et al., 2020) shows the VSWQ-C to have excellent concurrent validity ($r > .7$) with longer measures such as the KIDSCREEN-10 (Ravens-Sieberer & Kidscreen Group Europe, 2006), suggesting it successfully taps into global well-being.

The Obsessive Compulsive Inventory - Child Version (OCI-CV) (Foa et al., 2010). The OCI-CV is a 21-item child-report measure assessing obsessive compulsive symptoms in children and adolescents aged 7+ years. Children responded on a 3-point scale from *Never* to *Always*, describing events from the preceding month. The scale was adapted from an adult version (Opakunle et al., 2017) and shows robust test-retest reliability, and concurrent validity with clinician-rated OCD symptom, as well as divergent validity with anxiety symptoms (Foa et al., 2010).

Satisfaction with Life Scale-Child (SWLS-C) (Gadermann et al., 2010, 2011). The SWLS-C is a 5-item measure for children and adolescents to self-report their life satisfaction. It is an

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adaptation of the adult *Satisfaction with Life Scale* (Diener et al., 1985), and children responded using a 5-point Likert scale (from *Disagree a lot* to *Agree a lot*). Its five items are: *In most ways my life is close to the way I would want it to be; The things in my life are excellent; I am happy with my life; So far I have gotten the important things I want in life; and If I could live my life over, I would have it the same way.* (Gadernann et al., 2010, 2011) have successfully demonstrated the measure's construct validity, and convergent and discriminant validity.

The Screen for Childhood Anxiety Related Disorders (SCARED; (Birmaher et al., 1997; Birmaher, Khetarpal, et al., 1999). The SCARED is a parent-completed 41-item questionnaire which screens for anxiety symptoms. Scores measure overall anxiety, with additional subscales of *Panic Disorder, General Anxiety, Separation Anxiety, Social anxiety and School Avoidance*. Questions are presented as statements, which parents rate based on their child over the past three months. For example, Item 36 relates to school avoidance and states *My child is scared to go to school*. Parents respond on a 3-point Likert scale: *Not true or hardly ever true/ Somewhat true or sometimes true/ Very true or often true*. This widely used measure is reliable in a number of ways, including in terms of internal consistency, test–retest reliability, and parent–child agreement (Birmaher, Brent, et al., 1999; Birmaher et al., 1997; Birmaher, Khetarpal, et al., 1999).

Results

Identifying children with misophonia.

In the adult questionnaire related to the scale used here (Rinaldi et al., 2021), scoring involves summing the 39 Likert-scale responses in Part 2 (coded 0-4; giving a score out of 156), and

comparing the total score to the validated adult threshold for misophonia². In children however, this threshold is unknown. We therefore take a conservative approach by considering the prevalence of misophonia in adults (19-20%; Wu et al., 2014; Zhou et al., 2017) and applying half this prevalence to children. Specifically, we set the child threshold at the 90th percentile of total SMS-A scores. This captured all children scoring 49 or higher, and we point out that this threshold is approximating the adult threshold on this scale (50.5; (Rinaldi et al., 2021). Our conservative approach will allow us to be confident that we are identifying genuine child misophonics. (i.e., it aims to reduce false positives over false negatives).

Using this threshold score, we identified n15 children with misophonia. This group comprised 9 girls (mean age 11.67, SD 1.32) and 6 boys (mean age 11.00, SD 0.89). The remaining 127 children were designated controls, and comprised 56 girls (mean age 11.67, SD 1.22) and 71 boys (mean age 11.83, SD 1.03). This relatively small sample has great value in being the first identified by screening of a population, rather than self-presenting at clinic. As such, they represent the body of children with misophonia in the population at large. With 15 misophonics and 127 controls, we can detect effect sizes of $d = .77$ with power=.80 and alpha=.05.

Do children with misophonia show poorer well-being?

In our analyses, we first ran assumptions checks, which confirmed significant skews in our data across all measures. These skews are expected with wellbeing data, and reflect the fact that the

² The comparable adult measure does not provide a score for Part 1 (triggers). Instead, it allows users to compare their own triggers against an ordered ranking. This ranking shows triggers listed from most to least common, according to a norming sample of ≈150 adults with misophonia (Rinaldi et al., 2021). However, since this ordered ranking is not known for children, we omit this here. Similarly, the adult measure had sufficient numbers of people with misophonia to show that they select significantly more triggers than controls. Our child sample also showed this same trend (mean for misophonics = 3.46 SD =3.91 ; mean for controls = 1.45 SD = 2.97) but our small sample size failed to show significance at the conventional alpha ($t(13.63) = -1.79, p = .095$). We therefore look to future studies where the nature of triggers for childhood misophonia can be better understood.

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majority of participants have no problems in their wellbeing, so score at one extreme end of the test (e.g., within the Obsessive Compulsive Inventory, most participants will not have any obsessive compulsive symptoms and therefore score 0). To address this skew, we ran robust models where possible. We ran our group-wise analyses in R using “WRS2” for robust t-tests, and robust effect sizes using trimmed means. Given unequal sample sizes, a Hedges g correction may be applied. However our need for robust models combined with the fact that the robust effect sizes reported throughout are more conservative across the board, we report instead an explanatory measure of effect size ξ which holds the same interpretation as Cohen’s d (e.g., Values of $\xi = 0.10, 0.30,$ and 0.50 correspond to small, medium, and large effect sizes respectively) (Mahir & Wilcox, 2020). We additionally used the R packages “afex” for ANOVA, “emmeans” for post-hoc estimated means tests, and “tidyverse” for general data wrangling.

We first considered our child-report measures. We began with our two well-being measures where scores are summed across items, and low scores correspond to poorer well-being. Within the *Very Short Well-being Questionnaire for Children* (VSWQ-C; (Smees et al., 2020) the mean score for children with misophonia was 13.47 (SD 3.94) while the score for controls was 17.51 (SD 2.00). This difference was significant in a robust t-test ($t(8.88) = 4.50, p = .002$) with a large effect size ($\xi = 0.78$). We next looked at overall life satisfaction, (SWLS-C; (Gadermann et al., 2010, 2011) where children with misophonia scored 13.77 (SD 4.28) compared to controls who scored 20.01 (SD 4.45). Again, this difference was significant ($t(9.43) = 5.09, p < .001$) with a large effect size ($\xi = 0.78$).

Our final child-report measure was for obsessive-compulsive traits (using the OCI-CV; (Foa et al., 2010). Mean scores for children with misophonia were 24.36 (SD 6.44) compared to controls who scored 7.63 (SD 6.59). We explored the Obsessive Compulsive Inventory using

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a 2x5 mixed ANOVA crossing group (misophonics vs. controls) with subscale (*Checking and Doubling, Hoarding, Ordering, Obsessing, and Neutralizing*; see Figure 1). We found a main effect of group ($f(1, 123) = 64.95, p < .001$), a less interesting main effect of sub-scale ($f(4.13, 508.53) = 48.52, p < .001$; since scores are generally higher for some sub-scales over others), and an interaction ($f(4.13, 508.53) = 13.19, p < .001$). We ran post-hoc estimated marginal means tests to explore this interaction and found misophonics had significantly higher obsessive compulsive traits across each subscale of the OCI (see Figure 1) but where differences are especially notable for Obsessing (effect size 1.74) and Checking (effect size 1.53).

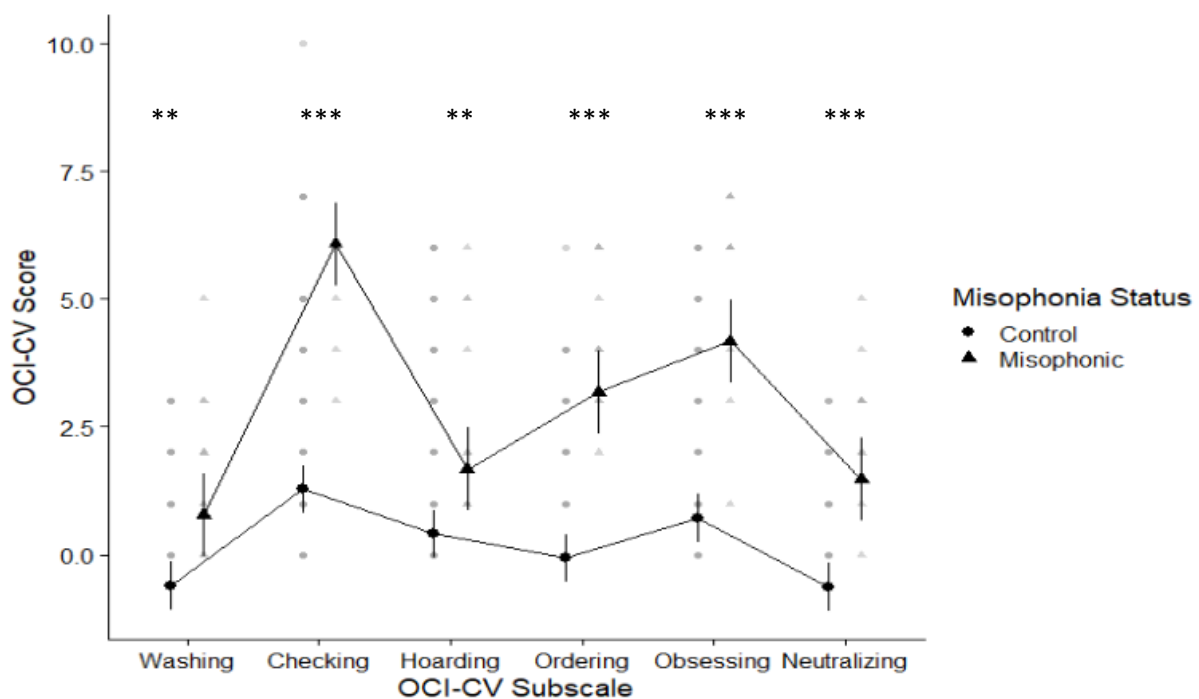


Figure 1. Means plot showing greater scores for misophonics (shown in triangle) and controls (shown in circles) in each of the OCI subscales (from left to right: *Washing, Checking and Doubling, Hoarding, Ordering, Obsessing, and Neutralizing*). Here and in all similar figures, means are shown with black circles/triangles, while grey points represent the raw data, with overlapping points appearing darker.

Finally, we looked at the parent-report measure for anxiety, using the SCARED (Birmaher, Khetarpal, et al., 1999). The overall score for children with misophonia was 31.50 (13.46)

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compared to 13.74 (14.22) for controls. We again explored the SCARED in a 2x5 mixed ANOVA crossing group (misophonics vs. controls) with subscale (*Panic Disorder, General Anxiety, Separation Anxiety, Social anxiety and School Avoidance*; see Figure 2) We found a main effect of group ($f(1, 113) = 14.35, p < .001$), a less interesting main effect of sub-scale ($f(3.32, 374.74) = 20.59, p < .001$, since scores are generally higher for some sub-scales over others) and an interaction ($f(3.32, 374.74) = 3.29, p = .020$). We again ran post-hoc estimated marginal means tests to explore this interaction and found that misophonics were significantly higher across all SCARED subscales except from *School Avoidance* (see Figure 2).

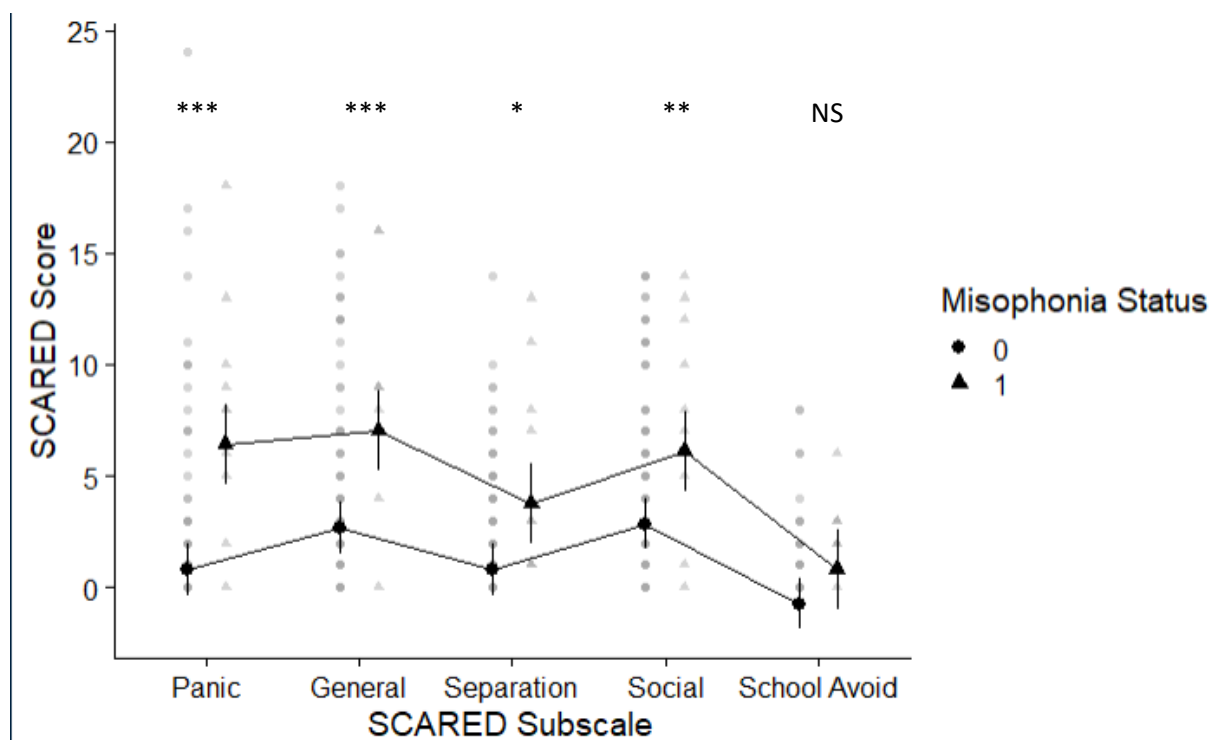


Figure 2. Means plot showing differences between misophonics (shown in triangle) and controls (shown in circles) in each of the SCARED subscales (from left to right: *Panic Disorder, General Anxiety, Separation Anxiety, Social Anxiety and School Avoidance*).

To end our analyses, we consider a possible objection to our placing the threshold for misophonia at the 90th percentile (49 or higher; see above). We suggest this is an appropriate threshold because it is not only conservative (i.e., under-estimating prevalence) but also almost

equivalent to the validated adult threshold (50.5; (Rinaldi et al., 2021). However, we also took a precautionary secondary approach, to consider the misophonia scale as a continuum and then re-analyse our measures using a correlational approach. To anticipate our results, we again found significance in all measures administered, mirroring our group-wise results above.

There was a significant negative correlation ($r = -.59, p < .001$) between misophonia scores and health-related quality of life (VSWB-C; (Smees et al., 2020). We found a similar relationship for satisfaction with life (SWLS-C; (Gadernann et al., 2010, 2011) score and SMS-A ($r = -.52, p < .001$). We next looked at obsessive-compulsive traits (OCI-CV; (Foa et al., 2010) which positively significantly correlated with both total and subscale scores, with all effects surviving correction. Effects ranged from small for the subscale *Hording* ($r = -.35, p < .001$) to high for the subscale *Neutralizing* and total OCI-CV (both $r = .69, p < .001$). Finally, we found significant positive correlations between misophonia scores and anxiety (SCARED; (Birmaher, Khetarpal, et al., 1999), in both total and subscale scores. These small effects ranged $r = .29$ ($p < .001$) for *Separation* and *Social Anxiety*, to $r = .38$ ($p < .001$) for Total score. See Table 2 for a full list of these correlations with anxiety and obsessive-compulsive traits.

Table 2 Correlations between misophonia scores and obsessive compulsive traits (OCI-CV) and anxiety (SCARED) for both total scores and subscales.

		Correlation with SMS-A (misophonia)	
		r value	p value
SCARED (anxiety)	Total	0.38	<.001
	General anxiety	0.34	<.001
	Panic disorder	0.35	<.001
	School avoidance	0.32	<.001
	Separation anxiety	0.29	0.001
	Social anxiety	0.29	0.001
OCI-CV (obsessive-compulsive)	Total	0.69	<.001
	Checking /doubting	0.61	<.001
	Hoarding	0.35	<.001
	Neutralizing	0.69	<.001
	Obsessing	0.58	<.001
	Ordering	0.59	<.001

	Washing	0.47	<.001
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Discussion

In this paper we examined the well-being of children with misophonia. These children showed significant differences in their well-being compared to peers without misophonia. They had poorer health-related quality-of-life (in the VSWQ-C; (Smees et al., 2019), poorer satisfaction with life (Gadermann et al., 2010) and higher traits associated with both anxiety disorder (SCARED; (Birmaher, Khetarpal, et al., 1999) and obsessive-compulsive disorder (Foa et al., 2010). Importantly, our screening for misophonia was child-completed, while at least one of our other measures was parent-completed (i.e., SCARED), meaning our results cannot be dismissed as a response bias (e.g., an acquiescence bias) since our data come from different individuals rating the same child.

Several previous studies have linked misophonia with poorer quality-of-life (Jager et al., 2020), and anxiety/ obsessive-compulsive traits (Cusack et al., 2018; Naylor et al., 2020; Schröder et al., 2013; Wu et al., 2014) -- but importantly, only in adults. The current study extends this finding into children for the first time, and importantly, children in the population at large rather than those who have self-referred to treatment clinics. (Our screening approach means we are almost certainly observing cases of misophonia that are likely to be as-yet unrecognised formally.) Prior to our study, there were no validated measures to identify childhood misophonia. Here we have introduced our adolescent screener (the SMS-A), adapted from a related adults scale (Rinaldi et al., 2021). Our measure can be found in full in our appendix, and our well-being findings offer convergent validity for this scale (i.e., showing that it significantly maps onto measures of anxiety, obsessive-compulsive traits, life-satisfaction and health related well-being). We have necessarily applied our scale conservatively, identifying

children in the 90th centile and above. But future studies might validate our measure more widely on larger samples of adolescent misophonics. A related goal is to also explore whether our measure has a factor structure, as it does in adults (see Footnote 1).

The poor pattern of well-being we have identified in children with misophonia requires close attention. Adults studies (e.g., (Wu et al., 2014) have suggested that misophonia is self-evidently related to anxiety and obsessive-compulsive disorders simply given symptomatology (e.g., negative reactions triggered by sounds, associated anxiety and distress, and corresponding avoidance/ compulsion). Here we note that obsessive-compulsive traits and misophonia may also be mediated by the factor of disgust. Disgust is a key emotional outcome of misophonia, but also shows important differences in OCD. Stein, Shapira and colleagues have linked OCD to a disruption in disgust processing, with more inappropriate disgust compared to controls, and with disruptions mediated by the insulin in both functional magnetic resonance imaging (fMRI; (Shapira et al., 2003) and positron emission tomography (PET; (Stein et al., 2006). This overlap between misophonia and OCD in both phenomenology and neural features may implicate disgust in their shared aetiology.

These findings of poorer well-being in children with misophonia (e.g., heightened anxiety) raise the question of causality. We have assumed that misophonia may be responsible for our target children's poorer well-being scores, although it is equally possible that children with poorer well-being (e.g., higher anxiety) may be more pre-disposed to developing misophonia. Of course these ideas are not mutually exclusive -- and development will also be mediated by environment and genetics. One genetic marker for misophonia has been identified in a report by the organisation 23andMe (Fayzullina et al., 2015). They examined n80,607 participants who were asked "Does the sound of other people chewing fill you with rage?" (Yes/No/Not Sure). After removing responses of 'Not Sure' and applying their criteria for genome-wide

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association significance (see https://permalinks.23andme.com/pdf/23-08_genetic_associations_with_traits.pdf)

Fayzullina et al. found a significant genetic locus associated with misophonia -- at least as far as they had phenotyped it with their single question. This locus, rs2937573 (chromosomal region 5q34), resides near the TENM2 gene, which encodes for the teneurin-2 protein, implicated in regulating synaptic connections during brain development (Tews et al., 2017; Vysokov et al., 2016). This finding supports evidence elsewhere of enhanced functional connectivity in misophonia (Kumar et al., 2017; Schröder et al., 2019). However, the four teneurin proteins also contain peptide sequences (teneurin C-terminal associated peptides; TCAP-1–4) which have been associated with anxiety behaviours in rats (Tan et al., 2009), and linked to structures implicated in other mood disorders (Woelfle et al., 2016). Future genetic studies may therefore hold the key for greater insight into the co-morbid relationship between misophonia and broader anxiety disorders.

Our results address a vacuum of knowledge concerning childhood misophonia, and highlight a pressing need for attention. We suggest that current and future research should promote actions to widen the public's understanding of misophonia. Our data on well-being also suggest that professionals should engage in an active screening for anxiety disorder and obsessive-compulsions in any child where misophonia is suspected. At the same time, researchers and clinicians might push for a wider understanding of the condition in schools. One way to achieve this is to open dialogues between parents and teachers, where information about misophonia can be shared. To achieve this, we have created an online information hub (www.misophonia-hub.org), a one-stop resources containing advice and support for adults, children, parents, researchers, clinicians and educators. The site also contains information factsheets about misophonia in both children and adults (e.g., our child factsheet is designed for parents to print, individualise, and share with their teacher). Feedback suggests our factsheets often provide well-needed validation for the “genuineness” of the child's reports, because children with

misophonia are often dismissed or disbelieved. Thus, impact has been at the heart of our research, and we propose a similar approach for future researchers. In summary, our study shows that misophonia can be identified in children aged 10-14 years, with negative implications for elevated anxiety and obsessive-traits, as well as poorer life satisfaction, and health-related quality of life.

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Appendix: The Sussex Misophonia Scale for Adolescents (SMS-A)

Part 1

We're going to ask you about things you see and hear every day. Have you always hated these things? Or don't you mind them? I hate... (*categories 1-8 are shown on screen; with sub-scale items revealed in the event of a positive response to the category*)

1 the sound of people eating yes/no

Which do you hate hearing? Tick all that apply.

crunchy foods (e.g. apples); crispy snacks; chewing; lip smacking; swallowing; slurping (a drink); wet mouth sounds (e.g., yoghurt); other

2 the sound of repetitive tapping yes/no

Which do you hate hearing? Tick all that apply.

pen clicking; foot tapping/ foot on floor; repetitive barking; tapping pen/ pencil; tapping finger; typing on a computer; other

3 the sound of rustling yes/no

Which do you hate hearing? Tick all that apply.

rustling paper; rustling plastic; other

4 throat sounds yes/no

Which do you hate hearing? Tick all that apply.

throat clearing; hiccups; humming; other

5 sounds people make through their mouth and nose yes/no

Which do you hate hearing? Tick all that apply.

breathing; snorting (e.g., when people laugh); nose sniffing; coughing; snoring; whistling; sneezing; burping; other

6 some voice sounds yes/no

Which do you hate hearing? Tick all that apply.

certain accents; some people's voices; certain letter sounds; certain vowels; certain consonants; other

7 repetitive visual movements yes/no

Which do you hate seeing? Tick all that apply.

repetitive leg rocking; foot shuffling; people rocking back and forth on their chair; other

8 some background sounds (e.g., fridge humming) yes/no

Which do you hate hearing? Tick all that apply.

clock ticking; car engines; refrigerator humming; dishwasher; washing machine/ dryer; fan; other

Part 2

How often do these things happen to you? (Likert responses: Never, Hardly ever, Sometimes, Often, Always).

1. Certain sounds make me feel disgusted, even if those sounds don't disgust other people.

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2. I have a problem because hearing certain sounds makes me unhappy.
3. I feel no one really understands that I have a problem with sounds.
4. I feel scared hearing sounds I don't like.
5. Other people make fun of me for hating sounds.
6. It hurts when I hear certain sounds, even if it doesn't hurt other people.
7. Sometimes I leave the room, to avoid telling people off for making bad sounds.
8. There are some sounds I hate so much, I shout at people.
9. Sounds often cause me physical pain.
10. I feel guilty because of my reaction to sounds.
11. I worry nobody can help with my sound problems.
12. I don't do well at school because of distractions from sounds.
13. I try to avoid going to people's houses if those people make sounds I hate.
14. I try to avoid going to school because of difficulties with sounds.
15. I hate people who make sounds I don't like.
16. I feel embarrassed about hating certain sounds.
17. Nobody believes my problem with sounds.
18. Hatred of some sounds make me feel lonely.
19. I feel physical pain if unable to avoid a sound.
20. The sound made by some people makes me feel the need to avoid them.
21. Problems with sounds has meant I don't have many friends.
22. My hatred of some sounds creates problems in school.
23. I'm worried about always having problems from hearing certain sounds.
24. I try not to let people know I hate certain sounds.
25. I feel pain on my body when I hear certain sounds.
26. My life is worse because of sound problems.
27. People think I'm crazy because of my reaction to sounds.
28. I cover my ears to block out certain sounds.
29. I've told some people they must not make certain noises around me.
30. Some sounds make me want to scream or cry.
31. I don't like school because there are lots of sounds I hate.
32. I suspect my friends think I'm weird, because of my reaction to sounds.
33. I react more strongly to some sounds if I'm having a bad day.
34. I say things aloud in order to avoid listening to bad sounds.
35. I want to hurt people who make sounds I hate.
36. I feel like people make sounds on purpose just to upset me.
37. I want to get pay-back on people who make certain sounds.
38. I think my problems with sounds are getting worse with age.
39. I put on headphones to block out certain sounds.

Scoring

Part 1. This section does not form part of the misophonia diagnosis, but researchers may wish to use this section for descriptive statistics (e.g., describing the number of triggers reported by their participant) or related analyses.

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Part 2. Likert responses are scored 0-4 (0-never; 1- hardly ever; 2-sometimes; 3-often; 4-always) and are then summed to give scores running from 0-156, where the passing threshold to indicate misophonia from this study was 49 or higher.