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Contagious Itch in Humans. A Study of Visual “Transmission” of Itch in Atopic Dermatitis and Healthy Subjects

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Abstract

Anecdotal evidence suggests “contagious” itch occurs in daily life when we see other people itch and scratch. This phenomenon has not been systematically studied previously, and factors which can amplify itch perception were unknown. We investigated whether exposure to visual cues of itch can induce or intensify itch in healthy and atopic dermatitis subjects. Participants received histamine or a saline control delivered to the forearm and were asked to watch short video clips of people scratching. Spontaneous scratching induced by visual cues was monitored and analyzed. Atopic dermatitis patients reported a higher itch intensity and scratched more frequently while watching itch videos, even in the presence of mock itch stimuli. Human susceptibility to develop itch when exposed to visual cues is confirmed and it appears amplified in atopic dermatitis sufferers. These findings suggest that interpersonal social cues can dramatically alter the subjective sensory experience of itch.

Introduction

It was anecdotally reported that itch can be “contagious by sight”: watching other people scratch can induce a surreptitious sensation of itch and an urge to scratch, although the exact mechanism underlying this type of “itch transmission” is not well understood. Insights into the mechanism that occurs in the brain to explain this response are presently lacking; if found, they could further our understanding of the central nervous system modulation of itch perception.

In this study, we aimed to establish first if the basic tenets of a “contagious itch” model are reproducible in a controlled environment. We examined the effect of visual stimuli of itch, presented in short video clips depicting people scratching, on the perception of a local itch induced experimentally on the forearm. We also analyzed the spontaneous scratching behavior induced while being exposed to itch videos. Secondly, we were interested to evaluate if the response to visual cues of itch displays any particularities in chronic itch sufferers (atopic dermatitis patients) in comparison to healthy volunteers.

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Materials and methods

The experimental protocol was approved by the Internal Review Board of Wake Forest University Health Sciences. A signed informed consent was obtained from all subjects. All experiments have been conducted according to the principles expressed in the Declaration of Helsinki. Study participants comprised of 14 healthy volunteers (8 males, 6 females, average age of 27.1 ± 7.7 ; range 18 to 54) and 11 atopic dermatitis patients (3 males, 8 females, 32.7 ± 12.0 years old, range 19 to 49). Atopic dermatitis subjects presented a mild to moderate condition, as assessed by Hanifin-Rajka criteria and EASI scores¹⁻².

Exposure to visual stimuli—Participants were asked to watch short video clips of 5 minutes, depicting people scratching their left forearm, or a neutral content video as a control, depicting the same persons shown in the scratching videos, but sitting idle.

Sequence, blinding and randomization—The order of administration of the actual itch stimulus (histamine) or mock stimulus (isotonic saline) was randomized as well as the type of the videos. Participants were not informed about the nature of the solution administered at any given time.

Rating of itch—Participants rated the average intensity of itch they perceived at the end of each session, using a Visual Analog Scale (VAS) ruler graded from 0 to 10.

Scratching: participants were allowed to freely scratch their itch at any given time during viewing of video material.

Video capture of scratching behavior: While the subjects watched the video material, they were also videotaped unobtrusively, from an angle that captured images of their entire body. Video recordings were examined to describe the characteristics of all spontaneous scratching episodes performed by participants. The frequency, duration and localization of scratching episodes were extracted from the video recordings.

Induction of itch sensation—Itch was evoked by histamine iontophoresis applied to the ventral forearm, approximately 5 cm above the wrist. Histamine was applied to non-lesional skin in atopic dermatitis subjects. For iontophoresis, a 1% solution of histamine dihydrochloride dissolved in 2% methylcellulose gel (Sigma, St. Louis, USA) was administered at a current of $200 \mu\text{A}$, for 30 seconds (Perimed PF3826 Perilont Power device; Perimed, Sweden). An isotonic aqueous solution was used alternatively as a control and was “delivered” also by iontophoresis. These local stimuli were applied immediately prior to playing the video clips.

Making of the video clips showing people scratching—Video recordings were made of various volunteers scratching their left forearm, after induction of itch by histamine iontophoresis in the same fashion as described above. A panel of 12 (healthy) raters selected the most convincing itch & scratching recordings, by visual analog scale (VAS) ratings of itch intensity, as conveyed by the videos; subsequently, a final montage 5 minutes in length was cut. The video displayed three individuals, interspersed in video clips of 30 seconds each. In order to provide a neutral content video as a visual cues control (free of scratching images), another video montage was made, displaying the same persons that appeared in the “itch video”, but sitting idle (relaxed).

Analysis of scratching episodes and their duration—Spontaneous scratching bouts captured on video recordings were examined. Information on the characteristics of the underlying itch was extracted in respect to the extension, duration and localization of

scratching motions. Skin areas targeted by scratching were classified by their spatial extension: 1) strictly localized (up to ~ 5 cm, basically confined to the local site where itch or control stimulus was applied; or to the wheal and flare areas induced by histamine, when histamine iontophoresis was used), 2) “limited” to the same forearm, 3) “extended unilaterally” on the same arm (beyond the forearm, e.g. to the arm or shoulder) and 4) extended bilaterally, *beyond* the arm where local itch stimulus was applied. These included contralateral areas (if applicable). In the analysis of scratching bouts, primary measures were the number of episodes (frequency) and the overall duration (in seconds). Areas [1 + 2] were then collapsed in “localized” (limited to the forearm), i.e. locally confined episodes, and [3 + 4] in “extended episodes”. Subsequently, the ratio between these local/extended episodes was calculated. Areas targeted by scratching in atopic subjects were carefully examined to establish if they were eczematous or non-eczematous.

Statistical analysis—The VAS ratings of itch intensity reported at the end of each session and several parameters describing the scratching behavior were analyzed. The number of scratching episodes and the duration of scratching episodes (in seconds) per session were classified in relation to the extension of area scratched (localized, limited, extended unilaterally, extended bilaterally) and were analyzed by a mixed model taking into account subject effects. Comparisons were performed to contrast the effect of itch video exposure versus exposure to neutral video within the same group (atopics or healthy) for the same stimulus (saline or histamine), and also across groups. Multiple comparisons were Bonferroni adjusted. All analyses were performed using PASW 18.0 software and statistical significance was set at $p < 0.05$.

Results

A. The effect of visual cues on the perception of itch intensity when a saline control was delivered to the forearm

AD patients watching videos of itch reported the intensity of itch sensation significantly increasing from 0.82 to 2.51 ($p = 0.027$) as reported on a visual analog scale, VAS (0 to 10) compared to watching a neutral video, *when a mock itch stimulus was delivered*. The perception of itch increased minimally in healthy volunteers in the same settings (Fig. 1). Interestingly, nine out of 11 AD patients reported an increase in itch sensation, while for two of them the ratings were unchanged. Six out of fourteen healthy volunteers indicated higher VAS ratings of itch.

The analysis of scratching behavior of AD patients and healthy subjects revealed that atopics watching the itch video doubled the overall duration of scratching episodes. Atopics watching the itch video in the presence of a saline control scratched more frequently in *areas extended beyond the local itch site* ($p = 0.001$), while the difference in scratching between these 2 groups when viewing neutral video was just a trend ($p = 0.09$). Atopics scratched twice as much (in duration) at ‘extended’ sites, as they scratched the local site: when a control solution was delivered, for 34 seconds in extended areas (on average) and 15.6 seconds locally when watching an itch video, versus 17.4 seconds in extended areas and 8.4 seconds locally when watching a neutral video (Fig. 2). Atopic dermatitis patients watching itch videos scratched in widespread areas for a longer duration than healthy subjects watching itch videos [$p = 0.002$].

B. Analysis of itch sensation intensity and scratching behavior when an active itch stimulus was delivered

When histamine was delivered by iontophoresis as the local itch stimulus and was paired with itch videos, atopic subjects doubled the overall duration of scratching (in contrast to

histamine administration paired with neutral videos) and directed scratching mostly towards areas widely distributed over their body, well beyond the site of local stimulus application (Fig. 3). The ratio of extended versus local scratching episodes changed from 0.84 to 3.21, when the video was switched from neutral to itch video (Fig. 4). At the first pairing of histamine with itch videos, the intensity of itch sensation increased, but not to a significant degree. When histamine was delivered for the second time, scratching frequency and duration increased even more in atopics, while the perception of itch intensity was also significantly increased from 3.5 to 5.9 (on a 0–10 scale).

Analyzed by ANOVA, the gender of participants did not have an impact on the perception of itch ratings or scratching behavior.

Discussion

Psychological factors have been implicated in the induction or exacerbation of itch in various forms. In the medical community, it has been observed that a discourse about scabies (or pruritus in general) may produce the intriguing effect that listeners start to itch and scratch. Exposure to images suggestive of itch during a lecture has been reported to increase scratching in the audience³. Although the “visual transmission” or contagion of itch was occasionally reported in daily life, it has not been investigated in a systematic manner previously.

In this study we examined the effect of visual cues of itch on the perception of a local itch induced experimentally and in the induction of scratching, in a controlled setting. Atopic dermatitis participants reported a significant increase in the perception of itch while watching itch videos, even when only a control solution was delivered to their forearm. A possible explanation of this phenomenon is the central mediation of “contagious” itching within superior relays of CNS involving the “mirror neuron” system in the prefrontal cortex^{4–6}. It is conceivable that the neuronal networks or mechanisms underlying contagious itching may be similar with the ones involved in contagious yawning, a phenomenon that is still intensely studied, but not exactly elucidated⁷. Brain imaging studies directed at deciphering the neuronal networks involved in the contagious induction of itch by visual means would be of interest to pursue in the near future, expanding on these observations. It is equally important to note that the amplification of itch perception upon visual exposure to itch cues was manifest in the healthy group, albeit at a lower magnitude. It is therefore possible that the acute response of AD subjects to visual stimuli may represent an amplification of a built-in mechanism also present in the general, healthy population. The mechanisms involved in the amplification of itch perception observed in atopic dermatitis patients may shed light onto central neural pathways that aggravate chronic pruritus. Interestingly, AD patients were reported to be more susceptible to suggestion, in a manner than can aggravate itch: if atopic dermatitis patients were informed prior to a histamine prick test that histamine-induced itch is “uncontrollable and unpredictable”, 90% of them reported an increased itch or developed an amplified urticaria⁸.

In our study, in the presence of a real itch stimulus (histamine), atopic subjects shifted to scratching areas widely distributed over their body, well beyond the site of histamine application, when an itch video was presented (Fig. 3). The ratio of scratching in extended / local sites increased 3.8 times in atopics when the video was switched from neutral to itch video (respectively). Importantly, the skin areas targeted for scratching by atopics were not eczematous. Video-induced scratching extended bilaterally and was consistently stronger in the atopic population than in the healthy group. This scratching behavior in AD displayed vigorous attempts to quench a surreptitious, widespread itch sensation that apparently “gained” a larger distribution upon exposure to “itch” videos. Scratching decreased at the

local site, therefore the effect of the video appeared to induce mostly a scattered itch sensation manifested in other areas of the body. We infer that the scratching response in extended bilateral areas mostly represents a “contagious” form of itch primarily induced by visual means. It appears that the main mechanism for the induction of the scattered itch by visual cues has to operate within the higher structures of the central nervous system. The lack of spatial specificity of scratching behavior suggests that viewing of another individual experiencing itch may potentially result in an attentional tuning of somatosensory processing mechanisms such that ongoing or spontaneous itch-related afferent activity is amplified sufficiently to reach subjective awareness. Alternatively, this effect may parallel a nocebo-type process (*pruricebo*), where strong top-down attentional factors result in the misinterpretation of non-itch related afferent input as being related to itch. We mention in this context that brain areas described in fMRI studies as significantly activated in atopic dermatitis⁹ such as bilateral insula, dorsal anterior cingulate cortex and putamen, were also implicated in the nocebo effect¹⁰.

Contagious itch may represent another expression of humans’ ability to emulate others and it could also be seen as a form of empathy¹¹. It is possible that the mechanism by which humans subconsciously respond by developing itch and an urge to scratch upon seeing a fellow human scratch, is a remnant of collective-social behavioral conditioning that was more pronounced in earlier primates, which was somewhat conserved. Alternatively, contagious itch can represent a manifestation of a high degree of susceptibility to mental or visual suggestions that is inherently human.

These observations may lead to further findings that could help identify and target the central nervous mechanisms involved in the induction or amplification of itch in humans, for the benefit millions of itch sufferers.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Figure 1.

The perception of itch intensity increased significantly in atopic dermatitis subjects when they watched itch videos, in comparison to watching neutral videos, while the perception of itch increased just slightly in healthy volunteers. Visual Analog Scale ratings $\pm$ S.E.M.; visual analog ratings are expressed on a scale from 0 to 10. Saline = control delivered on the forearm; Neutral = neutral content videos.

Figure 2.

Distribution and average duration of scratching episodes (in seconds $\pm$ S.E.M.) per extension area in AD and healthy subjects, exposed to itch and neutral videos in the presence of mock itch stimuli (0.9% aqueous saline). Localized episodes included scratching bouts limited to the same forearm where the local itch stimulus was applied; extended episodes included scratching motions extended beyond the same arm where itch stimulus was delivered and which exhibited a widespread distribution.

Figure 3.

The distribution of scratching episodes in widespread (scattered) areas, in atopic dermatitis (AD) patients and healthy subjects, reveals that AD patients experienced an itch that extended beyond the local itch induction site, becoming generalized, while they watched itch videos (in red). Scratching beyond the local site in healthy participants was limited to the face, neck and the contralateral forearm (in blue). The areas scratched are shown in ranking order (by average duration) for an exposure to itch videos, when the local itch stimulus (histamine) was delivered to the right forearm (i.e. scratching on the *contralateral forearm* is represented). Atopic dermatitis subjects scratched mostly their contralateral forearm (1), mid-back region (2), face (3), neck (4) and scalp (5). {Note. Colored areas indicate in a figurative manner the location of scratching sites and are not intended to depict to scale the extension of the skin surface scratched}.

Figure 4.

The average duration (in seconds $\pm$ S.E.M.) of extended versus localized scratching episodes in AD and healthy participants when a local itch stimulus (histamine) was paired with neutral and itch videos. Localized episodes included scratching bouts limited to the same forearm where the local itch stimulus was applied; extended episodes included scratching motions extended beyond the same *arm* where itch stimulus was delivered and which exhibited a widespread distribution.