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Behavioral Management of Migraine Headache Triggers: Learning to Cope with Triggers

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Abstract The literature on migraine triggers is reviewed, including the most common triggers, interactions between triggers, the research evidence related to the capacity of self-reported triggers to precipitate headaches, and the neurobiologic pathways by which triggers induce migraine attacks. An argument is developed against the standard advice to avoid migraine triggers as the best way of preventing attacks, based on conceptual and practical criticisms, and consideration of cognate literatures on chronic pain, stress, and anxiety. A small number of studies suggest that exposure to headache triggers has the same effect as exposure to anxiety-eliciting stimuli, with short exposure associated with increased pain response and prolonged exposure associated with decreased pain response. On the basis of this literature, "learning to cope with triggers" is advocated, where controlled exposure and approach/confront strategies are used to manage migraine triggers, except in cases where such an approach would probably be inappropriate.

Keywords Migraine · Headache · Migraine triggers · Coping · Behavioral management

Introduction

Clinicians and researchers in the field of migraine have a long-standing interest in the triggers of migraine attacks, on the basis that if triggers can be identified and avoided, then no more migraine attacks should occur. The standard advice for decades has been to identify and avoid triggers as the best means of preventing migraine. Researchers regularly make this point in articles, for example, stating that "Comprehensive migraine treatment programs emphasize awareness and avoidance of trigger factors as part of the therapeutic regimen" [1]. One of the "seven elements of good headache management" listed by the World Health Organization is "identification of predisposing and/or trigger factors and their avoidance through appropriate lifestyle change" [2]. Similar advice appears on numerous Internet sites. For example, the American Headache Society website's "Instructions for Patients" provides a handout entitled "Trigger Avoidance Information," which includes an "Identifying Headache Triggers Worksheet." Even the popular Wikipedia site, under "Prevention of Migraines," says "Patients should attempt to identify and avoid factors that promote or precipitate migraine episodes."

Despite the universal advice to avoid them, research on triggers is limited, and research evaluating the efficacy of the advice is almost nonexistent. We have challenged this advice in a series of articles, most recently in a review [3••] and a viewpoint [4•]. The present review discusses what is known about migraine triggers, criticizes encouraging avoidance of triggers as a preventive strategy, and offers what we believe to be a more defensible approach to behavioral management of migraine triggers, referred to as "learning to cope with triggers."

Migraine Triggers

Migraine triggers have been defined as "factors that, alone or in combination, induce headache attacks in susceptible individuals" [5]. Triggers (also called precipitating or

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provoking factors) usually precede the attack by less than 48 h. A recent study by Kelman [6••] found that 76% of migraineurs responded affirmatively when asked whether they could identify triggers for their migraine attacks, but this figure rose to 95% when individuals were asked to respond to a specific list of triggers. This study found the mean number of triggers reported per patient to be 6.7 with almost two thirds of patients reporting four to nine triggers.

Blau and Thavapalan [7] note the often expressed view that "everything can produce a migraine." Several studies have quantified the percentage of headache sufferers who report different triggers of their attacks. The results from seven studies published between 2001 and 2008, involving more than 2500 migraineurs from six countries, are presented in Table 1. Some interpretation was needed in deciding which figures to include in the table because different authors label triggers and group triggers differently.

The studies presented in Table 1 are 1) Kelman [6••]—clinical sample from the United States of 1207 individuals diagnosed as migraine with or without aura, and chronic migraine; 2) Deniz et al. [8]—clinical sample from Turkey of 185 individuals diagnosed as migraine with or without aura; 3) Ierusalimschy and Moreira Filho [9]—clinical sample from Portugal of 100 individuals diagnosed as migraine without aura; 4) Spierings et al. [10]—clinical sample from the Netherlands of 38 individuals diagnosed as migraine; 5) Karli et al. [11]—clinical sample from Turkey of 23 migraine with aura, 33 migraine without aura, and nine with typical aura with nonmigraine headache (the latter group was omitted from the table and the two migraine groups were combined); 6) Zivadinov et al. [12]—community sample from Croatia of 720 individuals diagnosed as migraine; and 7) Fukui et al. [13]—clinical sample from Brazil of 200 individuals diagnosed as migraine.

Inspection of Table 1 reveals that stress/tension is the most widely cited migraine trigger, and this conclusion was

Table 1 Percentages of migraine patients reporting triggers in seven recent studies

Migraine triggers	Studies						
	Kelman [6••]	Deniz et al. [8]	Ierusalimschy and Moreira Filho [9]	Spierings et al. [10]	Karli et al. [11]	Zivadinov et al. [12]	Fukui et al. [13]
Stress/tension	80	71	76	84	80	58	65
Menstruation	65	31	39	57	59	46	54
Visual disturbance	38	32	75[a]	50	27	39[a]	NA
Noise	NA	42	75[a]	53	NA	39[a]	NA
Odors/smells	44	26	75[a]	61	29	39[a]	36
Hunger/not eating	57	42	48	82	73	NA	64
Specific foods/drinks	27	33	46	58	34	12	64
Alcohol	38	28	NA	42	4	NA	34
Weather	53	17	NA	71	48	45	NA
Heat	30	NA	NA	NA	NA	NA	NA
Lack of sleep	50	48	49	74	54	36	62
Sleeping late/excess	32	NA	27	NA	25	NA	44
Exercise	22	NA	20	42	20	37	13
Fatigue/tiredness	NA	22	35	79	NA	NA	NA
Straining	NA	NA	NA	42	NA	NA	NA
Sexual activity	5	1	3	NA	7	NA	3
Head/neck movements	NA	NA	2	NA	9	NA	NA
Neck pain	38	NA	NA	NA	NA	NA	NA
Head trauma	NA	NA	20	NA	NA	NA	NA
Coughing/sneezing	NA	NA	NA	7	NA	NA	1
Smoking	NA	16	1	NA	NA	NA	11
Smoke	36	NA	NA	61	NA	NA	NA
Travel/trips/driving	NA	9	4	29	NA	53	NA

[a] Two studies presented one figure for "sensorial stimuli" or "afferent stimuli"

NA not available

drawn in many other studies [14]. Stress is the most important trigger for males and females [15] and for children as well as adults [16]. Menstruation is an important trigger for female headache sufferers. The role of sensory factors (ie, visual disturbance, noise, and odors/smells) is clear in the table; other triggers that stand out are hunger and lack of sleep.

Triggers may not operate independently; the occurrence of one may increase the likelihood of exposure to one or more other triggers. For example, monthly hormonal changes in women may increase the probability of the consumption of certain foods [17]. The simultaneous occurrence of more than one trigger may result in an aggregative effect; indeed, some candidate triggers may not be capable of eliciting headaches without the presence of an additional trigger, at least for some individuals. For example, Blau and Thavapalan [7] note that some women know they can drink wine without inducing an attack except during the premenstrual week, and O'Banion [17] argued that diet may influence the severity of problems produced by monthly menstrual cycles. Nicolodi and Sicuteri [18] found that low doses of alcohol were much more likely to lead to migraines when consumed on stressful occasions.

Most of the research on triggers is based on retrospective self-report; hence the validity of the data is challenged by the possibility of selective memory and the patient's need for causal explanations [19•]. Some researchers have used a prospective methodology, however, including several studies that have instructed headache sufferers to self-monitor headaches and stress, and reported positive relationships between the two [20]. Wober et al. [19•] instructed 327 migraineurs to self-monitor their headaches and precipitating factors for a period of 3 months. Menstruation emerged as the most important trigger. Other significant triggers included stress/tension, tiredness, noise, and odors/smells. Szyszkowicz [21•] recently presented impressive evidence linking weather conditions and air pollution to headaches. Martin et al. [22–24] experimentally validated several commonly reported headache triggers including negative affect/stress, "visual disturbance" (flicker, glare, and eye strain) [23], noise [24], and hunger [22]. Not all studies investigating triggers have reported supportive results. The evidence pertaining to food as a trigger is equivocal [25], and a recent review concluded that alcohol is not a major trigger [26•]. Even stress as a trigger for migraine was challenged in a recent study that found no significant temporal relationship between subjective and objective measures of stress and the onset of migraine attacks [27•].

The large number of identified headache triggers raises the question of whether triggers precipitate headaches by the same or different neurobiologic pathways. Burstein and Jakubowski [28] have hypothesized that different migraine triggers (eg, stress, perfume, and awakening) activate a wide variety of brain areas, but that a common descending pathway accounts for the activation of meningeal nociceptors. They argue that the perception of migraine headache arises from the nociceptive signals originating in the meninges. Lambert and Zagami [29•] have hypothesized that trigger pathways can originate in different areas of the cortex but converge at the level of the brainstem. Specifically, cortical activation by migraine triggers (including cortical spreading depression) inhibits neuronal discharge in the brainstem and facilitates trigeminal sensation.

Arguments Against Advising Avoidance of All Migraine Triggers

One problem with advising trigger avoidance is that such advice is given in a conceptual vacuum because we do not understand how triggers precipitate headaches. Researchers write about triggers as though the capacity to precipitate a headache is an inherent and immutable property of the trigger itself, with individual differences in sensitivity to triggers considered as genetically determined [30]. This conceptualization ignores the fact that migraine is an acquired disorder. Individuals are born with varying predispositions to develop headache disorders, but studies have shown that monozygotic twins are concordant for migraine in only 20% to 50% of cases [31], so that at least 50% of those carrying a genetic predisposition to migraine never experience attacks. This raises the question of what processes account for the development of a headache disorder, or what processes lead to potential triggers acquiring the capacity to precipitate headaches. If the history of exposure to triggers is a salient factor, then encouraging avoidance may change trigger potency. Put simply, if headache sufferers are encouraged to avoid triggers, perhaps tolerance for triggers will diminish.

From a practical perspective, there are problems associated with the advice to avoid all triggers. Complete avoidance of all potential headache triggers is unlikely because they are so diverse and omnipresent, and attempting to do so could result in a very restricted lifestyle [6••]. Marcus [32] pointed out that the effort to avoid every potential headache trigger may itself be stressful.

If strong empirical support existed for encouraging avoidance of triggers, then the above questions would be of theoretical interest only; however, such support is limited to a small number of group studies and case reports, none of which included relevant control conditions and all of which are liable to several methodologic criticisms. Blau and Thavapalan [7] provided perhaps the strongest evidence by encouraging migraineurs to avoid all precipitating

factors, and reporting a 50% reduction in attack frequency in 19 of 23 patients. However, these authors also advised their patients "how to abort attacks by quickly taking an antinauseant and analgesic tablets," so the effects of this advice were confounded with the effects of the advice to avoid precipitants [7]. Also, the study compared a retrospective estimate of attack frequency in the 3 months before consultation with "noting attacks" during the 2 months after consultation, meaning that pre–versus post-intervention differences potentially could be attributable to the differing measurement approaches used on each occasion. The study did not assess treatment adherence or include a follow-up.

Consideration of cognate literature raises concerns about the advice to avoid headache triggers. In the chronic pain literature, fear-avoidance models contend that individual differences in pain response lie on a continuum spanning extremes of confrontation and avoidance [33]. Individuals who confront their pain are considered more likely to adaptively resume physical and social activities, whereas those who respond to pain with significant anxiety and avoidance (eg, catastrophic thinking and avoidance behavior) are considered more likely to enter a self-perpetuating vicious cycle that maintains and exacerbates pain perception, leading to chronic pain and related disability.

In the stress literature, Snyder and Pulvers [34] argued that research findings indicate that coping with stress generally takes one of two routes: avoidance or approach. They noted that the weight of evidence demonstrates that the avoidance-coping pathway is not adaptive, with a few important exceptions. Hayes et al. [35] argued that higher levels of "experiential avoidance," a type of avoidant coping, are associated with higher levels of general psychopathology, depression, anxiety, specific fears, and trauma, and a lower quality of life.

The anxiety literature has demonstrated that short exposure to anxiety-provoking stimuli results in *increased* subsequent anxiety responses to the stimuli, whereas prolonged exposure to anxiety-provoking stimuli results in *decreased* subsequent anxiety responses [36]. Short exposure—resulting from attempts to avoid or escape from anxiety-eliciting situations—underlies the maintenance of fears and phobias. In contrast, exposure-based approaches (eg, systematic desensitization, flooding, and implosion) have been used with great success to treat a wide range of anxiety disorders [37]. Moses and Barlow [38] recently proposed a new unified treatment approach for emotional disorders (defined as the anxiety and unipolar mood disorders), which includes preventing emotional avoidance (including both behavioral avoidance and cognitive avoidance) and facilitating emotional exposure.

Several studies have investigated hypotheses with respect to headache triggers derived from the anxiety literature. Philips and Jahanshahi [39] proposed that exposure to a salient pain-provoking stimulus would lead to increasing tolerance through a process of adaptation, whereas avoidance of the stimulus would increase the potency of such stimuli to provoke pain. To test these predictions, chronic headache sufferers were exposed to noise. The results showed that exposure under optimal conditions (relaxation) was effective in reducing pain behaviors, whereas avoidance of exposure to potent stimuli led to increasing intolerance.

Martin [40] exposed headache and nonheadache participants to the headache trigger of "visual disturbance" (flicker, glare, and eye strain) for one of five durations ("none," "very short," "short," "long," and "very long"). Reports of head pain differed significantly as a function of length of exposure to the trigger. Nociceptive response was greater for the "short" exposure condition than the "none" and "very short" exposure conditions; however, the nociceptive response in the "very long" condition was less than in the "short" condition, and more closely approximated the nociceptive response in the "none" and "very short" conditions. In summary, the results were in accord with the anxiety literature in that short exposure increased nociceptive response, whereas very long exposure decreased nociceptive response. The study was repeated for the headache triggers of noise [41] and stress [42], with similar results.

Martin [43] completed a study in which six headache sufferers (four migraine and two tension-type headache) repeatedly attended the laboratory for sessions involving exposure to visual disturbance, paired with relaxation in some sessions. All participants had suffered from regular headaches for more than 10 years, and all reported that visual disturbance was a headache trigger. The results demonstrated that repeated, prolonged exposure to this trigger led to desensitization. With six sessions of exposure, ratings of visual disturbance decreased from baseline by 44%, negative affect by 54%, and headache intensity by 63% in response to the trigger. During the study period, participants kept headache diaries, in which they recorded hourly ratings of head pain throughout the waking day; analysis of the diary data revealed that average pain ratings dropped by 19%. This finding is consistent with substantial desensitization to one headache trigger, although other triggers retained the capacity to precipitate headaches.

Learning to Cope With Triggers: An Alternative to Advising Avoidance of All Triggers

The trigger avoidance model of headaches is based on the premise that one etiologic pathway to developing a headache disorder is via trying to avoid or escape from triggers, leading to short exposure and subsequent increased sensitivity or decreased tolerance for the triggers [3••, 4•].

Some individuals are probably more susceptible than others to developing headaches via this pathway. The learning literature is replete with examples of interactions between genetic and environmental factors. For example, the anxiety literature talks about "fears born and bred," that is, innate versus learned fears. (This topic was addressed in a special issue of *Behaviour Research and Therapy*, volume 40, issue 2, 2002.) Conditioning theories place emphasis on the environment (fears are learned), but accept the role of heredity in determining which stimuli are most likely to become fear-provoking and who is most likely to learn to fear. Non-associative theories suggest that we are "born to fear" but still acknowledge the role of the environment in accounting for the fact that many individuals subsequently learn not to fear—that is, habituation occurs through "safe exposure."

Such a model implies that advising avoidance of all migraine triggers is not appropriate because it may lead to fewer headaches in the short term, but is likely to lead to more headaches in the long term via mechanisms such as sensitization, reduced tolerance, failure to habituate or adapt, or lack of opportunity to develop coping resources. The reverse strategy of encouraging planned exposure may serve several different functions. First, it can act as an experiment to see if the alleged trigger precipitates headaches. As reviewed above, the research evidence pertaining to triggers varies from "good but not unequivocal" to "tentative." Individuals can easily be misled with respect to their own triggers. For example, hunger (low blood sugar level) leads to eating certain foods like chocolate, and a headache may ensue. The headache sufferer may interpret such a sequence to mean that chocolate caused the headache, when it was the low blood sugar level that triggered the headache. Once individuals have drawn such conclusions, they often avoid the "trigger" and thus do not have the opportunity to realize that it is not a trigger. Hence, encouraging exposure to the "trigger" may reveal that it is not capable of precipitating headaches, at least unless it is present in an extreme form.

A second function of exposure is to see if it is possible to set up desensitization, habituation, or adaptation to the trigger, as appeared to occur in the studies by Martin et al. [40, 41, 43] using visual disturbance and noise as triggers. This model is used to treat anxiety disorders, even though after many years of research it is still not clear why exposure is an effective treatment for anxiety [44].

A third function of exposure is to enable headache sufferers to practice coping skills for which they have received training in response to the trigger. This approach is used in the stress literature. In a review written more than 30 years ago, Meichenbaum [45] argued that "actual exposure during training to less threatening stressful events has a beneficial effect." This principle was incorporated into stress inoculation training [46], which has been applied successfully to a diverse array of clinical disorders including phobias, other anxiety-related disorders, anger, and pain.

Consideration of the literature on coping with stress provides insight with respect to managing migraine triggers. Stress researchers have identified a range of stress coping strategies that can be organized hierarchically. For example, one study identified eight primary factors (problem solving, cognitive restructuring, emotional expression, social support, problem avoidance, wishful thinking, self-criticism, and social withdrawal), four secondary factors (combinations of problem-focused vs emotion-focused, and engagement vs disengagement), and two tertiary factors (approach and avoidance coping) [47]. The stress literature demonstrates that no single coping strategy can be selected as the best way of coping with stress for all situations and across time; however, reviewers of this literature drew general conclusions (eg, approach strategies generally are more adaptive than avoidance strategies) and specific conclusions (eg, avoidance can work better in acute situations, but the opposite approach of attention to threat is more adaptive in the long term) [48].

We would argue that rather than advising avoidance of triggers, a philosophy of "learning to cope with triggers" is more adaptive, because coping includes a wide range of strategies, some of which are classified as "avoidance." Sometimes an avoidant strategy will be the strategy of choice. For example, exposure to a trigger that is not healthy (eg, car exhaust fumes or dehydration) clearly should be avoided. On the other hand, well-established protocols for treating stress and anxiety use exposure-based approaches that seem worthy of consideration when these are important triggers. With respect to sensory stimuli, we have used planned exposure successfully with migraine sufferers. For example, a patient who experienced migraine as a result of spending much time at work looking at a computer screen was encouraged to take a break after an interval less than the length of time required to induce a headache. After the patient adapted to this length of time, the length of exposure was increased. Hunger and lack of sleep are triggers that are probably best avoided; however, if patients become too obsessional about avoiding them, they may lose their tolerance for even minor levels of hunger and sleep deprivation. Food and drink are not often significant triggers, and exposure is likely to reveal that they do not precipitate headaches. Menstruation is not open to behavioral manipulation, but a trigger management program for female patients may involve using time of the menstrual cycle as a cue for coping strategies to deal with other triggers that may aggregate with hormonal factors to precipitate headaches.

This review has emphasized that stress is the most common trigger of migraine. We discussed previously how vicious cycles are created because headaches are themselves stressors,

which not only can lead to a negative feedback loop of stress-headache-stress, but also reactions to headaches that make stress more likely to occur in the future, such as headache-driven irritability leading to arguments with spouses, in turn resulting in marital discord, and thereby increasing the likelihood of more stress in the future [49]. Lake [50•] recently discussed headache as a stressor, and argued that "Functional coping styles rely on flexibility and balance, with a willingness to directly confront the experience of pain in a calm and intentional way." We would advocate the same approach for managing migraine triggers generally.

In summary, we are not arguing that "avoidance of triggers" should be replaced with "exposure to triggers," but avoidance often will not be the strategy of choice, and judgment needs to be exercised regarding the most adaptive approach to dealing with myriad triggers. If no success is achieved when one strategy is adopted, then a different strategy may be needed. Exposure to triggers has to be managed judiciously, because it would clearly be undesirable to precipitate severe headaches.

A shift to a philosophy of "learning to cope with triggers" has significant implications because this approach is much more complicated and time-consuming than simply advising avoidance. As such, this approach is not likely to fit into the schedules of most medical practitioners, and emphasizes the need for a multidisciplinary approach to migraine care.

More research is needed on triggers. Currently, we list as triggers "stimuli" on the one hand (eg, noise, certain foods), and "responses" (eg, stress, anxiety) on the other. It is not clear whether apparently different triggers have features in common that explain why they are headache triggers (eg, stress). Research should address empirical validation of triggers and investigate how multiple triggers interact. The anxiety literature provides interesting concepts to explore with headaches. For example, anxiety sensitivity (fear of anxiety) has been shown to be a cognitive vulnerability factor for anxiety disorders, and fear of pain has been implicated in the development and maintenance of chronic pain behavior. Would "headache sensitivity" (fear of headache) be a cognitive vulnerability factor for headache disorders, perhaps mediated by trigger avoidance? Randomized, controlled trials are needed on how best to manage migraine triggers.

Conclusions

We have argued that the traditional advice that the best way to prevent migraine is to avoid the triggers is problematic because it is difficult to achieve and lacks empirical support. Cognate literatures on chronic pain, stress, and anxiety suggest that avoidance is not an adaptive strategy in most situations and that approach/confront/exposure strategies usually are more effective, at least in the long term. Some studies on headaches suggest that, like anxiety, short exposure to a headache trigger results in an increment to the head pain response, whereas longer exposure results in a decrement to the head pain response.

Therefore, a case was made for "learning to cope with triggers" as an alternative approach for the behavioral management of migraine triggers. This approach would use controlled exposure to triggers to induce desensitization/habituation/adaptation whenever practical, reserving avoidance for triggers for which exposure was clearly not an appropriate strategy.

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