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EDITORIAL

Successful treatment of nightmares may reduce psychotic symptoms in schizophrenia

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Abstract

Nightmares occur more frequently in patients with schizophrenia than they do in the general population. Nightmares are profoundly distressing and may exacerbate daytime psychotic symptoms and undermine day-to-day function. Clinicians do not often ask about nightmares in the context of psychotic illness and patients may underreport them or, if nightmares are reported, they may be disregarded; it may be assumed that they will disappear with antipsychotic medication and that they do not, therefore, require separate intervention. This is a missed opportunity because Image Rehearsal Therapy, among other psychological and pharmacological interventions, has proven effective for nightmares in non-schizophrenia populations and should be considered at an early stage of psychotic illness as an important adjunct to standard treatment. There is active ongoing research in this field, which will undoubtedly benefit patients with schizophrenia in the future.

Key words: Sleep; Nightmares; Psychosis; Nightmare-inducing drugs; Image rehearsal therapy

Core tip: A substantial percentage of persons suffering from psychotic illness such as schizophrenia experience frightening nightmares that aggravate their disease symptoms. New treatments for nightmares in the general population are starting to be applied to schizophrenia patients, as are new treatments for other associated sleep problems. This is very promising research that clinicians need to heed, as the lessening of nightmare distress will also help to alleviate daytime psychotic symptoms.

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INTRODUCTION

Hearing or imagining malevolent threats is the hallmark

of delusions and hallucinations in people with psychotic illness; it is also the stuff of nightmares. The DSM-5 identifies nightmares as being extremely distressing, long-lasting, and well-remembered dreams that involve threats to survival, security, or physical integrity. There are many ways in which the delusions and hallucinations of psychotic illness overlap with the substance of nightmares: in the centrality of the protagonist to the plot of the story line, in the illusion of reality despite improbable circumstances, in the thematic content (persecution, danger, humiliation) and in the resulting emotions[1,2]. Nightmares can be conceptualized as forming part of the ego disorders that lead to "bizarre" or unreal delusions, considered by Bleuler as fundamental dimensions of schizophrenia[3,4]. Bleuler also believed that the thought disorders found in schizophrenia mirrored the condensation, displacement and symbolic distortions that characterize dreams and nightmares[5].

Almost everyone experiences nightmares occasionally, and they are especially commonplace in childhood. About 50%-60% of children aged 5 to 10 years have frequent nightmares[6] and approximately 2.5% of these children continue to have nightmares after the age of 10[7]. Prevalence studies in adults report that from 2% to 6% of the general population have frequent (one or more per week) nightmares[8,9], but that the prevalence is higher in psychiatric patients[8,10,11].

NIGHTMARES AND SCHIZOPHRENIA

In the context of schizophrenia, approximately 10% of persons with this diagnosis have been reported to experience frequent nightmares[12]. Some reports place the prevalence from somewhat to substantially higher in schizophrenia[13]. Although frequency is important, it is the distress of the nightmares that predicts both psychopathology and day time function[14] because nightmares interfere with restorative sleep and because the distress experienced at night carries over to the day.

Compared to bad dreams, nightmares are more bizarre or outlandish; they usually involve violence, and the narrative almost always ends in failure and misfortune for the dreamer. The usual reaction to nightmares is terror[15]. For reasons of personality traits or past experience, some individuals are more at risk than others, both for nightmare frequency and for the resulting distress[16]. What is clinically worrisome is that, even when a person with a diagnosis of psychotic illness reports the disturbing occurrence of nightmares (which they do not do unless specifically asked), it is rarely addressed in therapy. This is in marked contrast to the deliberate clinical targeting of nightmares when reported by persons with a diagnosis of posttraumatic stress syndrome. Nightmares need to be addressed in the context of schizophrenia for three main reasons. Firstly, they can be early warning signs of impending psychotic illness requiring early intervention[17,18]. Secondly, they often signal increased delusional severity as well as cognitive decline and, therefore, may require treatment reconsideration[12]. Thirdly, there is a strong association between nightmares and suicide, which demands serious attention[19-23].

TREATMENT PERSPECTIVE

The first step toward treatment is always to inquire about bad dreams and nightmares during the initial assessment, and subsequently during follow up visits. Whenever these are endorsed, the next step is a drug screen because it is possible that drugs utilized to treat the patient are promoting the induction of nightmares[24,25]. The drugs that tend to do so fall into several main categories: Hypnotics, beta blockers, statins, dopamine agonists, anti-epileptics, antibiotics, and antidepressants. Anti-epileptics and antidepressants are frequently used to treat persons with psychosis and should be re-evaluated in the presence of nightmares. The most common agents used to treat psychosis are, of course, antipsychotic drugs, which, while able to dampen arousing dream content[26], have not, in general, been found effective for reducing the distress of nightmares, nor for lowering their frequency.

There are specific treatments that have been found effective for nightmares in the non-psychotic population and these are: (1) Relaxation (instructions about relaxing and practice exercises in breathing); (2) Recording (encouraging the writing out of the details of nightmares); (3) Imaginal exposure (deliberately reliving the nightmare in one's imagination); (4) Imagery rehearsal (deliberately changing the script of recurring nightmares, providing happy endings and frequently rehearsing the rewritten script); and (5) Lucid dreaming (learning to become aware during a nightmare that one is dreaming and then changing the script of the nightmare while still dreaming[27-31]. Lucid dreaming is interesting because neural correlates of lucid dreaming and of insight deficits in psychosis show striking overlap; fronto-parietal regions are involved in both phenomena[32].

Several specific pharmacological treatments for nightmares have also been evaluated. Prazosin, an anti-alpha adrenergic agent, has shown most evidence of efficacy[33-35]. Thus far, the therapies for nightmares with the most evidence to support their use are prazosin and Image Rehearsal Therapy (IRT)[35-37]. For those interested in understanding the procedure of IRT, I refer the reader to a very helpful online guide[38].

Specifically in reference to patients with psychosis, IRT has been successfully used for nightmares in inpatient psychiatric settings, but patients with psychosis were excluded from these studies on the assumption that they would not be able to follow instructions[39-41]. These studies do show, however, that IRT can be used safely and effectively in psychiatric hospital environments where patients tend to be severely ill. Sheaves *et al*[42] treated 5 patients with psychosis with IRT, too small a number to demonstrate effectiveness, but sufficient to show acceptability and feasibility.

The caveats of this approach are that effective treat-

ment of nightmares has not yet been convincingly demonstrated in individuals with psychosis, nor is there evidence that the alleviation of nightmares will reduce psychotic symptoms. On the other hand, psychotic patients are known to respond well to cognitive behavior therapies for other sleep conditions, such as insomnia[43,44], so the chances are that they will be able to respond equally well to nightmare therapies. Nightmares in this population may also respond to post traumatic stress disorder (PTSD) therapies since rapid eye movement (REM) sleep interruption correlates with nightmare complaints caused by stress[45].

Patients with psychosis themselves claim that treatment of sleep problems has a positive impact on many aspects of their lives[46]. The better their sleep is, the milder their psychotic symptoms. And vice versa: The less they suffer from psychotic symptoms during the day, the better they are able to sleep[39].

Clinicians also recognize the link, but the treatment of sleep disturbances in this population continues to be limited[47,48]. On the whole, mental healthcare providers are not well informed about the consequences of nightmares nor do they know about available treatment options[49,50]. Patients may underreport nightmares and rarely seek treatment for them, considering them irrelevant to their main concerns[51]. Mental healthcare practitioners may consider sleep problems as mere accessories to a larger psychiatric condition, and, thus, not requiring specific attention[52]. This is a missed opportunity because IRT has been shown to be an effective treatment for nightmares in other populations[40,53] and should be considered at an early stage of psychotic illness, as an adjunct to standard mental health treatment.

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EDITORIAL

Psycho-emotional content of illness narrative master plots for people with chronic illness: Implications for assessment

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Abstract

Illness narratives are stories of illness told by patients with chronic illness. One way of studying illness narratives is by considering illness narrative master plots. An examination of illness narrative master plots has revealed the importance of psycho-emotional information contained within the story that is told. There is a need for research to capture this information in order to better understand how common stories and experiences of illness can be understood and used to aid the mental well-being of individuals with chronic illness. The current editorial provides a suggestion of how this is possible. This editorial identifies that stories can be "mapped" graphically by combining emotional responses to the illness experience with psychological responses of the illness experience relating to hope and psychological adaptation. Clinicians and researchers should consider the evidence presented within this editorial as: (1) A possible solution for documenting the mental well-being of individuals with chronic illness; and (2) As a tool that can be used to consider changes in mental well-being following an intervention. Further research using this tool will likely provide insights into how illness narrative master plots are associated together and change across the course of a chronic illness. This is particularly important for illness narrative master plots that are difficult to tell or that are illustrative of a decline in mental well-being.

Key words: Illness narratives; Assessment; Emotions; Psychological adaptation; Hope

Core tip: This editorial provides implications for how illness narratives can be assessed. It identifies how and why the assessment is useful and crosses the academic disciplines of medical sociology and psychology.

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ILLNESS NARRATIVES AND THEIR IMPORTANCE

Illness narratives reflect stories told by patients about their experience of illness. The term narrative is generally regarded as including at least "one character who experiences one event" but most narratives will have multiple events associated together in a suggested causal sequence within a particular setting[1]. Health care professionals (HCP) can use illness narratives as an effective vehicle to help behaviour change in patients [2]. Being able to share narratives with HCPs enables a patient's agency, self-esteem and self-respect[3]. However, it is acknowledged that psychosocial, political and environmental factors influence a patients' shared expression[4-6].

There are clear reported benefits of using illness narratives for the purpose of rehabilitation compared to traditional rehabilitation approaches including, a reduced counter argument against advice given to patients from HCPs and greater illustration of pathways or strategies for managing illness[7]. The use of illness narratives can also reduce interactions which lack emotional support and create barriers to behaviour change[3]. This is important as emotional support is consistently associated with more positive psychological adaptation to chronic illness, whereas negative experiences of support may hinder cognitive processes associated with psychological adaptation and mental well-being[8]. The term mental well-being is defined as defined as satisfaction, optimism and purpose with life, a sense of mastery, control, belonging, and perceiving social support[9].

ILLNESS NARRATIVES MASTER PLOTS IN CHRONIC ILLNESS

Illness narratives contain a plot that often contains a beginning, middle and end[2]. Illness narrative master plots are common stories of illness that use a distinct or common plot as a response to illness, for an overview of 13 common illness narrative master plots see Soundy *et al*[10]. The master plots illustrate the impact of an illness on a patient focusing on key psychological attributes including emotions, adaptation and hope. Each master plots references time indicating psychological adaptation to what life was like in the past, what it is currently like and what it could be like in the future[10,11]. Different and seemingly contrasting illness narrative master plots can be told simultaneously by a patient, this is an important process as it reflects key stages in illness adaptation[11].

Illness narrative master plots generated out of loss and change from illness symptoms are some of the most important and critical stories told by people with chronic illness. They are important because certain illness narrative master plots can be difficult to hear or can be denied by others[12]. HCPs need to have an awareness of the psychological meaning behind a patient's narrative master plots. However, evidence has suggested that further understanding is needed[3] and that clinical practice may prevent or inhibit this, *e.g.*, as empathy can be lost through training[13].

NEED TO UNDERSTAND EMOTIONS, HOPE AND PSYCHOLOGICAL ADAPTATION WITHIN ILLNESS NARRATIVES

Specific emotions felt by a patient following chronic or palliative illness or symptom change will clearly influence subsequent their decision making and responses to illness[14]. Specific emotions can be related to specific cognitive processes, for instance, fear may be associated with a low level of perceived control over one's situation whereas anger can be associated with a high level of perceived control. It has been identified during times of change, including diagnosis or symptom change that patients with chronic illness express far more unpleasant than pleasant emotions. For instance, a recent review[15] that grouped emotional expressions as part of the experience of living with a chronic illness only identified one consistently pleasant emotion; relief (identified in 16/47 studies). Far more apparent were unpleasant activated emotions such as panic, fear or being scared (19/47), anger (15/47) or frustration (18/47 and deactivated unpleasant emotions such as sadness (12/47), depression (12/47), pessimism (7/47), or feeling upset (14/47). The impact of emotions on a patient's responses must have further consideration. If patients feel overwhelmed with fear or worry and powerless within the experience of illness the cognitions expressed by them may be more likely to lead to a succumbing illness response, dominated by an inability to access coping resources[16].

Research[11] has suggested that emotions, hope and adaptation can be assessed and used to represent the distinct narrative master plots by using the circumplex model of affect[17,18] to capture emotions alongside the hope and adaptation scale[19]. The latter scale requires the patient to identify what for them is perceived as most difficult aspect of their life to adapt to following an illness onset or change. This is then considered in relation to their own ability to adapt to what has happened and hope for change. These two brief scales have been combined together to represent a model of emotion, adjustment and hope[15]. As narrative master plots can be represented by particular psycho-emotional components[11], it is possible to suggest that these combined tools and model can be used to map illness

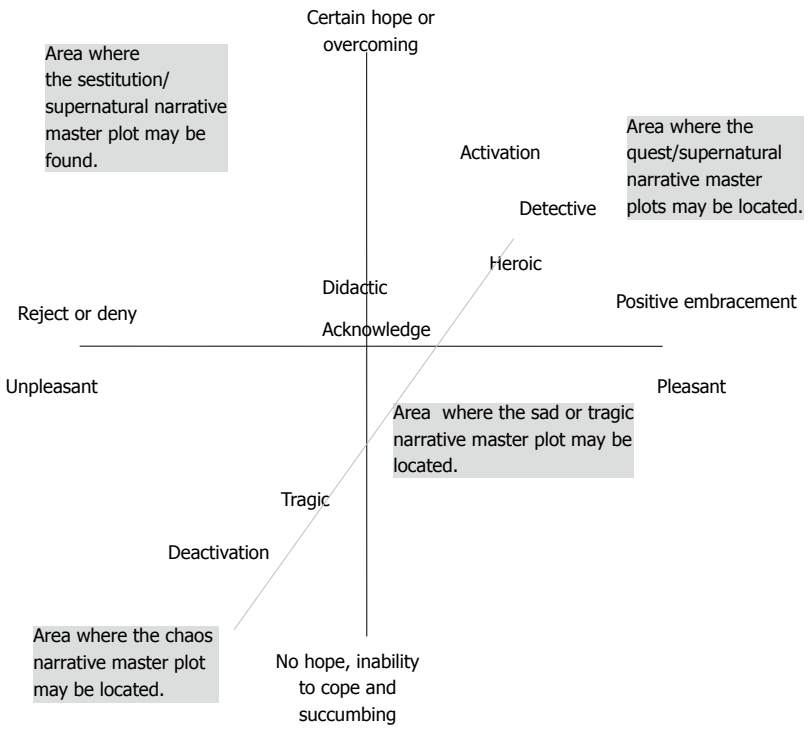

Figure 1 The possible placement and mapping of illness narrative master plots within the Model of Emotional Adjustment and Hope (Circumplex Model of effect on the horizontal axis, combined with the Hope and Adaptation Scale on the vertical axis).

narrative master plots (Figure 1).

NEED TO MAP ILLNESS NARRATIVE MASTER PLOTS

By mapping narrative master plots HCPs and researchers may be able to capture a patient's underlying psychological and emotional responses to illness. This enables a consideration of how; plots vary across time, what plots may be dominant for particular conditions or time following illness symptom change and how, and if, particular master plots are associated with one another. There is also a need to use the understanding of emotive and cognitive components of different master plots to target psychological interventions, *e.g.*, the emotional reaction expressed by a patient may be that of fear of what is happening which may cause them to want to escape or deny their circumstances[20]. In addition, understanding the cognitive processes of adaptation and hope may provide a point of discussion from where psychological intervention can begin.

HCPs should be able to map patient's response on a session by session basis, *e.g.*, HCPs by their responses have an opportunity to aid a patient's mood. For instance, a poor choice of words and an inability to listen may generate negative moods from interactions and be regarded as a perceived threat by an HCP. The mapping of illness narratives may provide greater clues to how particular narratives dominant or become dominant in a patient.

There is a need to consider how illness narratives are linked to one another and if targeting a particular aspect of the inventories is more effective. Further, there is a need to consider how changeable narratives are and if certain master plots are more resistant to change. Using tools identified above, narratives can be established and the meaning behind the narrative can provide a greater understanding and insight to the mental well-being of the patient.

CONCLUSION

Mapping an individual's master plots and understanding the psycho-emotional content of them may provide an essential tool for understanding the mental well-being of patients. Further research is needed in order to clarify and consider these points further.

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MINIREVIEWS

Single men seeking adoption

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Abstract

It was once impossible anywhere in the world for single adults to adopt children, and this is still the case in many jurisdictions. Elsewhere, however, single adults are now being actively recruited primarily because they are more willing than are married couples to adopt older or disabled children or to adopt across racial or other barriers. This is true for single men as well as for single women, but single men seeking to adopt continue to be widely viewed with skepticism and are reportedly often judged to be inappropriate parents. This paper reviews the sparse fostering and adoption literature on single heterosexual males and addresses the evident ambivalence with which parenting by single men is held among both child and adult mental health professionals. The paper also discusses the parenting styles of mothers and fathers, the ways that the central nervous system in both sexes has been found to respond to parenthood, the similarity of outcomes between single male and single female parenting, and the availability in North America of support and training for foster and adoptive single parents. The paper concludes that, in general, single men have as much to offer an adopted child as do single women and that seeming discrimination against them by childcare agencies requires investigation.

Key words: Single parents; Male adoption; Foster parents; Fathers

Core tip: Since contemporary definitions of masculinity have changed, men are no longer afraid to express emotions and to be nurturing fathers. More single men are now seeking to adopt children but, although male role models are very much needed for children in care, childcare agencies continue to be wary of single would-be fathers.

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INTRODUCTION

As much of the world's conceptions of family structure changes, a growing literature has arisen that addresses

single motherhood, as well as two-mother households and two-father households[1]. There remains, however, only a very modest childcare literature on single, especially single and heterosexual, fatherhood[2].

The relative lack of discussion of single male parenthood in the psychiatric and childcare literature is probably due to the assumption that heterosexual men have no innate desire for children unless they are in a committed relationship with a female partner. Motherhood is traditionally construed as central to a woman's sense of self[3], but relatively peripheral to a man's. Men are said to priorize career over family[4]. Exceptions to this generalization are generally acknowledged, however, especially in the case of gay men. Eighteen years ago, in 2000, one in five male same-sex couples were reported to be raising children[5]. Gay fathers, when interviewed[5] clearly articulated their motives for parenthood: They enjoyed the company of children, they valued family ties, they wanted to nurture and rear children of their own, particularly once they had reached a relatively mature stage of life and had achieved financial stability. Although, now that old-fashioned concepts of masculinity have become outdated[6], these same motives are likely to apply equally to heterosexual men, although the literature indicates that it remains somewhat unusual for unpartnered heterosexual men to actively seek fatherhood. This is the case despite the fact that, when comparing single mothers and single fathers, DeJean *et al*[7] found that single fathers were generally perceived in their communities in more positive terms than were single mothers. In contrast to single fathers, single mothers were described by participants in this study as "less intelligent, less desirable, less secure, less fortunate, less satisfied with life, less moral, less reputable, less of a good parent and less economically advantaged[7]." This perception of single fathers being "better" than single mothers is surprising. Surprising or not, it appears to do nothing to change suspicious attitudes among the general public and child care personnel about single fathers who seek to adopt children[8]. Should the single man seeking adoption have a history of a stigmatized condition, mental illness for instance, his chances of fostering or adopting children through either public or private channels become essentially nil[9,10].

Arbitrary restrictions to fostering and adoption based on demographics and discredited health conditions have become less intransigent over time, and most experts now agree that what is critical to successful adopting is filling the needs of the specific child, not concerning oneself with a would-be parent's marital status or psychiatric diagnosis. In the United States, single adults may now adopt in any state as long as they meet state-specific criteria for adoption[11]. In addition, over the last decade, many American States have added language to their child welfare statutes that protects persons with disabilities (this includes psychiatric disabilities) from discrimination when they attempt to exercise their fundamental right to create and maintain families[12]. Based on available statistics, however, most single adoptive parents continue to be female[13]; an apparent suspicion of would-be fathers remains prevalent[14]. It constitutes a form of anti-male sexism that is shared by many childcare professionals and is shown in a number of childcare proceedings, for instance by the failure to include fathers in case planning discussions around children, by the exclusion of birth fathers as placement options for children, and by home visits conducted when fathers are absent[14].

LITERATURE

The method for conducting this minireview was to scour the social work, psychology, childcare, and psychiatric literature for articles about fostering or adoption by single, heterosexual males. Very few articles were found.

MOTIVES FOR SINGLE FATHERHOOD

Motives for single full time fatherhood have been reported in Coles' ethnographic study of Black single birth fathers[15]. In that study (which was not about fostering or adoption), a sense of duty and responsibility led the men to become full time parents. They expressed a need to the interviewer to make up for their own fathers' absence, and a desire to model high quality fatherhood for their children[15]. At a June 2016 meeting sponsored by the Society for Research in Child Development, the consensus of an interdisciplinary group of scholars was that these same motives applied to single men, both gay and straight, who sought to foster or adopt children[16].

MALE FOSTER PARENTS

The literature on male foster carers[17] is almost always limited to males who are part of a married couple. Exceptions are Gilligan[18] and Newstone[19] who talked to a range of men who foster children, among whom were a few single males. Both these authors address the ambivalence towards males that, they claim, is often shown by childcare professionals. Both report that men are marginalized by social workers and childcare agencies because they are thought to represent a potential risk in the sense that foster fathers are often subject to improper sexual allegation. More rarely, men have, in fact, abused children in their care. Most child abuse in foster care is, as is true for aggressive acts everywhere, perpetrated by men[20]. On the other hand, a significant proportion of children who require fostering and adoption have, in their earlier lives, lacked a consistent male figure so that strong, dependable paternal role models are very much in demand. Over time, this demand has led to a gradual reconsideration of single males as potential foster parents. In 2003 in the United Kingdom, 20% of foster parents were unmarried singles. Two percent of these were single males[21]. The percentage today of single

male foster parents is unknown, but is likely to differ in different parts of the world.

SINGLE MALE ADOPTION

As early as 1977, Feigelman and Silverman[22] were reporting that adoption by single individuals, though historically considered "unthinkable" before the mid to late 1960s, had become possible in some jurisdictions as a result of the influx of growing numbers of children who needed a home. Singles were being actively recruited, they reported, for a specific reason - their relative willingness to adopt older, at-risk, and hard-to-place youth. It is known that the children who are adopted by single men through foster care in North America are usually older than average, more of them are disabled, and more of them are dark skinned[23,24]. In the Feigelman and Silverman[22] survey sample, 60% of single men adopted a child over 6 years of age whereas this was true for only 23% of single women and a mere 9% of couples. Forty-seven percent of single males in this sample adopted a child of a race different from their own, compared to 30% of single women and only 10% of couples. In 1997, Byrne[25] reported that 21% of children adopted by single males were physically or mentally disabled.

Despite the willingness of single men to adopt hard-to-place children, the majority of single adoptive parents continue to be women because childcare agencies are reportedly still making it relatively difficult for single men to adopt[23]. Although records of total adoption statistics (domestic, international, private) can never be totally accurate, it was estimated in 2015 that, of adoptions through foster care, only 3% (approximately) were by single men, most often gay men[23]. This may simply reflect the ratio of women to men who seek adoption, but it does suggest that childcare agencies are not actively recruiting men.

PATERNAL STYLES OF PARENTING

To better understand gender differences in parenting styles, Heslop[26] conducted an interview study of 23 foster fathers. The participants in this study were co-parents rather than single men, but their stories speak to the way contemporary men conceptualize their paternal role. The men in Heslop's study[26] filled traditional masculine parenting roles (as supporters and disciplinarians), but also felt comfortable in less traditional roles (sharing emotions and providing comfort to their children). Historically, male ways of parenting have been described as limited to roles such as encouraging friendships, teaching life lessons, and engaging children in active play[27,28]. Fathers have been described as interacting with their children mainly through the sharing of activities such as sports, yard work and home repair[29]. Many studies, however, indicate that, over time, fathers who stay at home with their children increase the amount of time they spend in care as distinct from play; they create relationships with children based not only on shared activities but also on emotional expressiveness, tenderness and love[30,31]. Hook and Chalsani[32] are of the opinion that, faced with identical tasks, parenting behaviors of single mothers and single fathers become progressively more and more similar, gender differences being overridden by the necessities of single parenthood. In her recent review of single father families, Coles[23] supports this view.

PLASTICITY OF THE PARENTAL BRAIN

In mammalian brain, the birth of offspring triggers a set of parental behaviors aimed to ensure the infant's survival. While it is well known that hormone levels play a defining role in this process in females, less is known about what happens in the male brain that prepares and sustains men when they become parents. Recently, significant brain changes have been identified in new fathers, changes that facilitate increased vigilance and socio-emotional engagement, changes that are similar, though not identical, to those found in new mothers[33,34]. In fathers, these brain changes are not driven by hormones but are activated by the experiences of childcare. It is postulated that these experiences provide emotional feedback that progressively shapes and patterns the paternal brain[33-35].

OUTCOMES OF CHILDREN REARED BY FATHERS

There has been no specific research on outcome parameters in children adopted by single men who are not their birth fathers. All single parent participants in outcome studies conducted thus far have been biological parents who are separated, divorced or widowed. Reviewing this literature, Biblarz and Stacy[36] report that, despite early findings that adolescents living with single mothers were more securely attached, had fewer behavioral problems, higher academic test scores and achieved higher educational and occupational status than those living with comparable single fathers, the literature as a whole concludes that children's achievements are essentially the same whether their single parent is a man or a woman. The Biblarz and Stacy review[36] hypothesizes that single-sex parenting fosters androgynous parenting practices, so that, as a result of necessity, the parenting styles of men and women become indistinguishable over time. These investigators found that, once family size was controlled, the number and severity of child behavior problems were similar whatever the single parent's gender. It has been known for some time that children in single-father or single-mother families do less well academically, on average, than children in two-parent families[37]. While this is true, and while parenting behaviors may also differ on average between single mothers and single fathers, Dufur *et al*[38] are of the opinion that such differences do not exert any perceptible

long-term effects.

OUTCOMES FOR MALE AND FEMALE PARENTS

Parenting is universally acknowledged as stressful and capable of contributing to mental ill health in mothers and fathers. A United States study[39] reported that continuously single fathers had significantly more mental health problems than continuously married fathers. This finding is supported by United Kingdom research on rates of common mental disorders in single parents of both sexes[40]. This research[40] found the risk to be almost twice higher in single compared to married mothers and almost three times as high in single compared to married fathers. Among the four groups (male single, male married, female single, female married), the lowest rate of mental disorder was found among married fathers. A relatively recent New Zealand study[41] with data on 905 single parents and 4860 partnered parents, found that 15.7% of single mothers and 9.1% of single fathers endorsed high to very high levels of psychological distress as compared to 6.1% of partnered mothers and 4.1% of partnered fathers. The relatively poorer mental health of single mothers compared to single fathers was attributed to socioeconomic factors since single women, on average, earn lower wages than single men.

CONCLUSION

This brief review about the current state of knowledge on single fatherhood strongly suggests that men on their own are able to adequately care for adopted children. This has been made easier since pre-adoption training and post-adoption support for single parenting is readily accessible in many parts of the world[42-45]. Support and training are important for all adoptive parents, but probably more so for single men for whom this continues to be, for the time being at least, a novel role. As pointed out by Atkinson and Riley[46], child and adult mental health professionals also require training so that discrimination against qualified would-be parents, whether single, male, gay, physically disabled or with a past history of psychiatric illness, ceases to dominate fostering and adoption decisions.

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ORIGINAL ARTICLE

Observational Study

Drinking plain water is associated with decreased risk of depression and anxiety in adults: Results from a large cross-sectional study

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Abstract

AIM

To investigate the relation between plain water drinking and risk of depression and anxiety among a large sample of Iranian adults.

METHODS

A total of 3327 Iranian general adults were included in this cross-sectional study. Validated Iranian version of the Hospital Anxiety and Depression Scale was used to assess anxiety and depression. Water consumption was assessed by asking about the number of glasses of water that consumed daily. Water consumption was categorized into < 2, 2-5, and ⩾ 5 glasses of water/d.

RESULTS

In the crude model, the lowest level of water drinking (< 2 glasses/d) compared with reference group (⩾ 5 glasses/d) doubled the risk of depression and anxiety (P < 0.0001). After adjusting potential confounders, this inverse link remained significant for depression (OR: 1.79; 95%CI: 1.32, 2.42; P < 0.0001), but not for anxiety (OR: 1.49; 95%CI: 0.98, 2.25; P = 0.109). In stratified analyses by sex, after controlling for potential confounders, water drinking < 2 glasses/d was associated with 73% and 54% increment in the risk of depression in men and women, respectively (P < 0.05), whilst no significant association was observed for anxiety either in men or in women.

CONCLUSION

We found inverse associations between plain water consumption and depression. Also, these findings showed a tended risky association, but not statistically significant, between lower levels of water consumption and anxiety. These findings warrant evaluation in prospective and clinical trials studies to establish the plausible role of water in mental health status.

Key words: Water; Anxiety; Depression; Psychological disorders; Iranian

Core tip: Evidence supports the relation between water consumption and health outcomes. Validated Iranian version of the Hospital Anxiety and Depression Scale was used to assess anxiety and depression. Water consumption was assessed by asking about the number of glasses of water that consumed daily. After adjusting potential confounders, an inverse link was observed between water and depression, but not for anxiety, though in the crude model both disorders were inversely related to water drinking. These findings warrant evaluation in prospective studies to establish the plausible role of water in mental health status.

Haghighatdoost F, Feizi A, Esmaillzadeh A, Rashidi-Pourfard N, Keshteli AH, Roohafza H, Adibi P. Drinking plain water is associated with decreased risk of depression and anxiety in adults: Results from a large cross-sectional study. *World J Psychiatr* 2018; 8(3): 88-96 Available from: URL: http://www.wjgnet.com/2220-3206/full/v8/i3/88.htm DOI: http://dx.doi.org/10.5498/wjp.v8.i3.88

INTRODUCTION

The prevalence of common psychological disorders has been increasing over recent decades[1,2]. Approximately, 29.2% of people are suffering from one of the common mental disorders worldwide[3]. Brain disorders, including both mental and neurologic disorders account for one-third of the economic cost of all diseases[4].

Drinking plenty of water is publicly believed to be useful for health and has been recommended in various dietary guidelines. Findings from a systematic review revealed that increased water consumption had a weight-reduction effect[5], and it has widely been known as an approach in weight-loss programs[6]. In addition, several studies have reported a bidirectional link between excess body weight[7,8] or diabetes[9] and mental disorders. It has been indicated that pathogenic substrates are the same in both metabolic and brain disorders; and therefore, the term of "metabolic-mood syndrome" has been suggested[10]. Lifestyle changes may to some extent explain the concurrency of obesity and mental disorders. Replacing water with sugar sweetened beverages might be the reason for inverse link between water consumption and obesity[11,12]. There is also evidence indicating the higher risk for mental disorders especially depression with higher consumption of sugar sweetened beverages[13], as well as higher glycaemic index diets[14,15].

Overall, accumulating evidence suggests that the beneficial relation between water ingestion and mental disorders is possible. However, the knowledge regarding beneficial effects of water consumption in mental health is rare. Water facilitates signaling pathway and nutrients delivery to the brain, removes toxins and inflammatory markers and provides energy sources for brain, and thereby improves brain function. Although several studies have shown that water insecurity is associated with psychological distress and anxiety[16,17], to the best of our knowledge, there is no study assessing the association between the water quantity and common

mental disorders including depression and anxiety. In the current study, therefore, we aimed to evaluate whether decreased plain water intake is associated with higher risk of mental disorders and whether it is gender-specific.

MATERIALS AND METHODS

Subjects

This cross-sectional study was carried out within the framework of the cross- sectional study on the Epidemiology of psychological, Alimentary health and Nutrition (SEPAHAN) project. The main aim of this project was to investigate the relationship between functional gastrointestinal disorders and lifestyle, nutritional factors and psychological profiles. The details of the project have been provided in Alibi *et al*[18] (2012). Briefly, the participants of the study were selected using multistage cluster and convenience sampling method amongst non-academic Isfahanian adults working at Isfahan University of Medical Sciences (IUMS) in 20 cities across Isfahan province. Each city was consider as a first stage's cluster and health centers affiliated to IUMS in each city were considered as second stage clusters and among them, considering the full coverage of geographic regions, some centers were selected randomly and those participants who were willing to participate in SEPAHAN study were recruited. In order to increase the participation rate and the data collection accuracy, the project was conducted in two phases. In the first phase, 10087 questionnaires were distributed to the participants, collecting information about anthropometric measures, demographic profile, lifestyle, nutritional factors and physical activity. 8691 completed questionnaires were returned in the first phase (response rate: 86.16%). In the second phase, psychological data were collected (response rate: 64.6%). Finally, after matching returned questionnaires in phase 2 with their equivalents in phase 1, we reached 4763 questionnaires. Of these, 2904 persons had complete information about both water consumption and psychological profile which were included in the statistical analysis. The study protocol was reviewed and approved by the ethical committee of Isfahan University of Medical Sciences.

Water consumption was assessed by asking about the average number of glasses of plain water that usually consumed in a day by each participant. The possible items to answer were < 2 glasses/d, 2-5 glasses/d and ⩾ 5 glasses/d.

Mental disorders assessment

A validated Iranian version of the Hospital Anxiety and Depression scale (HADS) was used to assess anxiety and depression[19]. HADS is a simple psychological questionnaire includes two separate parts to screen the severity of anxiety and depression. Each part includes 7 questions with a four-point rating scale (0-3); higher scores indicate greater degree of anxiety or depression. For both disorders, the score range is from 0 to 21. To identify the presence of either disorder, score 8 was considered as the cut point. Therefore, score 8 or greater were considered to have depression or anxiety and scores ⩽ 7 were considered normal[20].

Covariates assessment

Dietary intakes of participants were assessed using a valid and reliable 106-item dish-based food frequency questionnaire[21]. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2). The current level of participants' physical activity was assessed using General Practice Physical Activity Questionnaire[22] and participants were categorized as physically moderately active, active, moderately inactive and inactive. Because of close relation between gastrointestinal disorders and psychological health, we considered functional gastrointestinal disorders (FGID) as an important covariate in our analysis. Suffering from gastrointestinal disorders was assessed using a valid and modified Iranian version of ROME Ⅲ questionnaire[23]. FGID was defined as suffering from at least one of the following main gastrointestinal disorders: gastroesophageal reflux, dyspepsia, irritable bowel syndrome and constipation.

Statistical analysis

General characteristics in categories of plain water intake were reported as means and standard error (SE) or percentage for continuous variables and categorical variables, respectively. To examine the differences across plain water categories, analysis of variance (ANOVA) for continuous variables and χ^2 test for categorical variables were used. All dietary intakes were adjusted for age (yr) and weight (kg) by analysis of covariance (ANCOVA). Multiple logistic regression was used to estimate odds ratios (OR) (95%CI) for the presence of depression and anxiety across categories of plain water intake in crude and multivariable-adjusted models. In adjusted models, we controlled confounding impacts of age, sex, marital status (married, single, divorced, widowed), educational level (less than 12 years, 12-16 years and more than 16 years), BMI (continuous), smoking (non- and ex-smokers vs. current smokers), physical activity (moderately active and active vs. moderately inactive and inactive), FGIDs (Yes/No), intake of anti-psychotic medicines (Yes/No), and dietary intakes which play role in mental health [magnesium, riboflavin, pyridoxine, folate, cobalamin, Docosahexaenoic acid (DHA), Eicosa pentaenoic acid (EPA), energy, fibre and caffeine]. All confounders, including energy intake, were included in the statistical analysis as covariates. We performed stratified analyses, applying the above-mentioned models, by sex to evaluate potential modifying effect of sex related to mental health status. The adjusted models were also controlled for the same potential confounders, mentioned above. In all logistic regression analyses, *P* for linear trends was determined by Mantel-Haenszel

Table 1 General characteristic of participants across categories of plain water consumption

Variables	Plain water drinking			*P* value[1]
	< 2 glasses/d	2-5 glasses/d	⩾ 5 glasses/d	
Participants (*n*)	854	1764	709	
Age (yr)[2]	37.2 ± 0.3	36.1 ± 0.2	34.8 ± 0.3	< 0.0001
BMI (kg/m^2)[2]	24.7 ± 0.1	24.7 ± 0.10	25.5 ± 0.2	< 0.0001
Anxiety score[2]	4.0 ± 0.1	3.5 ± 0.10	3.0 ± 0.1	< 0.0001
Depression score[2] *n* (%)	6.8 ± 0.1	6.1 ± 0.09	5.3 ± 0.1	< 0.0001
Anxious	136 (16.2)	244 (14.1)	61 (8.7)	< 0.0001
Depressed	303 (36.0)	478 (27.7)	151 (21.6)	< 0.0001
Male	242 (28.3)	757 (42.9)	387 (54.6)	< 0.0001
Marital status				0.035
Married	680 (81.4)	1431 (82.9)	549 (78.8)	
Single	135 (16.2)	271 (15.7)	139 (19.9)	
Other	20 (2.4)	25 (1.4)	9 (1.3)	
Anti-psychotic medicines use	56 (6.6)	91 (5.2)	39 (5.5)	0.342
Current smokers	147 (17.2)	243 (13.8)	70 (9.9)	< 0.0001
Moderately active and active	303 (39.6)	729 (45.7)	350 (56.1)	< 0.0001
Educational level				0.005
⩽ 12 yr	333 (39.8)	633 (36.9)	301 (43.1)	
12-16 yr	438 (52.4)	956 (55.6)	347 (49.7)	
⩾ 16 yr	65 (7.8)	129 (7.5)	50 (7.2)	
FGID[3] (%)	488 (57.1)	892 (50.6)	321 (45.3)	< 0.0001
Nutrients[4]				
Energy (kcal/d)	2306.1 ± 30.1	2385.8 ± 20.7	2487.9 ± 34.7	0.001
Protein (% of total calorie)	84.3 ± 1.2	88.5 ± 0.8	93.2 ± 1.4	< 0.0001
Fat (% of total calorie)	95.5 ± 1.3	98.7 ± 0.9	103.1 ± 1.5	0.001
Carbohydrate (g/d)	285.3 ± 4.2	294.5 ± 2.9	306.3 ± 4.9	0.006
Fibre (g/d)	22.0 ± 0.2	22.5 ± 0.1	23.0 ± 0.2	0.003
Caffeine (mg/d)	106.7 ± 3.1	96.7 ± 2.2	96.0 ± 3.7	0.022
Magnesium (mg/d)	314.1 ± 4.3	327.2 ± 3.0	349.6 ± 5.0	< 0.0001
Thiamin (mg/d)	1.8 ± 0.03	1.8 ± 0.02	1.9 ± 0.03	0.062
Riboflavin (mg/d)	1.8 ± 0.03	1.9 ± 0.02	2.0 ± 0.03	< 0.0001
Pyridoxine (mg/d)	1.9 ± 0.03	2.0 ± 0.02	2.1 ± 0.03	< 0.0001
Folate (mg/d)	562.4 ± 5.8	573.8 ± 4.0	600.2 ± 6.7	0.801
Cobalamine (mg/d)	2.8 ± 0.05	3.0 ± 0.03	3.1 ± 0.05	< 0.0001
DHA (g/d)[3]	0.2 ± 0.01	0.2 ± 01	0.2 ± 0.01	< 0.0001
EPA (g/d)[3]	0.06 ± 0.003	0.1 ± 0.002	0.1 ± 0.003	< 0.0001
Food groups				
Fruits (g/d)	285.8 ± 8.7	322.4 ± 6.0	351.1 ± 10.1	< 0.0001
Vegetables (g/d)	215.4 ± 4.8	241.4 ± 3.3	264.7 ± 5.5	< 0.0001
Nuts, legumes and soy (g/d)	55.5 ± 1.5	56.8 ± 1.0	60.9 ± 1.7	0.047
White meat (g/d)	59.4 ± 1.8	64.03 ± 1.2	67.5 ± 2.02	0.009
Red meat (g/d)	75.4 ± 1.8	78.4 ± 1.2	84.5 ± 2.06	0.004
Refined grains (g/d)	401.6 ± 7.1	390.7 ± 5.4	389.4 ± 9.11	0.473
Whole grains (g/d)	39.5 ± 2.9	40.8 ± 1.1	52.1 ± 3.40	0.007

[1]Derived from one way ANOVA and chi-square test for continuous and categorical variables, respectively and analysis of covariance (ANCOVA) for nutrients and food groups; [2]Values are means ± SEs; [3]FGID defined as suffering from at least one of the following gastrointestinal disorders: Gastroesophageal Reflux, dyspepsia, irritable bowel syndrome and constipation; [4]The nutrients were adjusted for age and body weight. DHA: Docosahexaenoic acid; EPA: Eicosa pentaenoic acid.

extension chi-square test. All statistical analyses were done using Statistical Package for Social Sciences (SPSS, Inc., Chicago IL, United States; version 20). $P < 0.05$ was considered significant in all statistical analyses.

RESULTS

In terms of water intake, participants were categorized into three major classes (< 2 glasses, 2-5 glasses, ⩾ 5 glasses/d). Those consumed more water had higher BMI ($P < 0.0001$) and were more probably to be younger, male, physically active (all $P < 0.0001$) and single ($P < 0.05$), but less educated compared with those who consumed less water ($P = 0.005$). Greater plain water drinking was associated with lower prevalence of smoking, anxiety, depression ($P < 0.0001$). Consistently, those consumed greater plain water had lower anxiety and depression score compared with those in the lowest category of plain water intake (< 2 glasses/d) ($P < 0.0001$). Water consumption was strongly associated with increased risk of FGID ($P < 0.0001$) (Table 1). Greater plain water consumption was associated with higher intakes of energy, protein, fat, carbohydrate, fibre, magnesium, riboflavin, pyridoxine, cobalamin, docosahexaenoic acid (DHA), eicosa pentaenoic acid (EPA), fruits, vegetables and red meat (*P* for all <

Table 2 General characteristics of participants based on categories of anxiety and depression *n* (%)

	Depression		*P* value[1]	Anxiety		*P* value[1]
	Yes (28%)	No (72%)		Yes (13.1%)	No (86.9%)	
Age (yr)[2]	36.3 ± 0.3	36.1 ± 0.2	0.562	35.4 ± 0.2	36.3 ± 0.3	0.020
BMI (kg/m^2)[2]	24.8 ± 0.1	24.9 ± 0.1	0.712	25.0 ± 0.2	24.9 ± 0.1	0.636
Male	285 (30.2)	1082 (46.0)	< 0.0001	117 (26.1)	1251 (43.9)	< 0.0001
Anti-psychotic medicines	106 (11.2)	76 (3.2)	< 0.0001	70 (15.6)	113 (4.0)	< 0.0001
Current smokers	164 (17.4)	290 (12.3)	< 0.0001	84 (18.8)	370 (13.0)	0.001
Moderately active and active	338 (39.7)	1028 (48.8)	< 0.0001	155 (38.5)	1212 (47.4)	0.001
Educational level			< 0.0001			< 0.0001
< 12 yr	153 (16.7)	236 (10.2)		84 (19.3)	306 (11.0)	
12-16 yr	715 (78.1)	1876 (81.4)		337 (77.5)	2255 (80.9)	
⩾ 16 yr	48 (5.2)	194 (8.4)		14 (3.2)	228 (8.2)	
Marital status			0.001			0.001
Married	733 (79.4)	1901 (82.4)		361 (83.2)	2274 (81.3)	
Single	163 (17.7)	380 (16.5)		58 (13.4)	486 (17.4)	
Other	27 (2.9)	26 (1.1)		15 (3.5)	38 (1.4)	
FGID[3]	665 (70.5)	1022 (43.4)	< 0.0001	357 (79.7)	1329 (46.6)	< 0.0001
Water drinking			< 0.0001			< 0.0001
< 2 glasses/d	303 (32.5)	539 (23.1)		136 (30.8)	706 (25.0)	
2-5 glasses/d	478 (51.3)	1246 (53.4)		244 (55.3)	1481 (52.4)	
⩾ 5 glasses/d	151 (16.2)	548 (23.5)		61 (13.8)	639 (22.6)	

[1]Derived from independent t-test and chi-square test for continuous and categorical variables, respectively; [2]Values are means ± SEs or percent; [3]FGID defined as suffering from at least one of the following gastrointestinal disorders: Gastroesophageal Reflux, dyspepsia, irritable bowel syndrome and constipation.

0.01). Tiamin, folate, white meat, refined grains, whole grains, nuts, legumes and soy consumptions were not significantly different across the categories of plain water intake.

Table 2 presents the general characteristics of study population stratified by the status of anxiety or depression. Individuals, who were anxious, but not depressed, were younger than healthy subjects. The prevalence of both depression and anxiety was higher among women, anti-psychotic medicines users, smokers and individuals who suffered from FGID. Conversely, healthy subjects were more probably to be physically active or moderately active, have higher education levels and drink more glasses of water. Whilst depression was less prevalent among married individuals, anxiety was more prevalent.

Crude and multivariable-adjusted ORs (95%CIs) of depression and anxiety across the categories of plain water intake are illustrated in Table 3. Compared with the reference group (⩾ 5 glasses/d), lower levels of water consumption (< 2 glasses/d) was associated with a greater chance of having depression (OR: 2.04; 95%CI: 1.62, 2.56; P < 0.0001) and anxiety (OR: 2.02; 95%CI: 1.46, 2.78; P < 0.0001) in crude model. Adjustment for multiple potential confounders slightly weakened these associations, but remained strongly significant for depression (P < 0.0001). However, after adjustment for dietary intakes, the lower levels of plain water consumption was a risk factor for anxiety however the significant link disappeared (for < 2 glasses/d: OR: 1.49; 95%CI: 0.98, 2.25, and for 2-5 glasses/d: OR: 1.58, 95%CI: 1.08, 2.30; P = 0.109; *vs* ⩾ 5 glasses/d).

In all crude and adjusted models, lower levels of water consumption (< 2 glasses/d) compared with the reference group (⩾ 5 glasses/d) was associated with a greater chance of having depression either in men or in women not only in crude but also in fully adjusted models (2-5 glasses/d: OR: 1.54; 95%CI: 1.00, 2.36 and < 2 glasses/d: OR: 1.73; 95%CI: 1.02, 2.93; P = 0.04) for men and in women (2-5 glasses/d: OR: 1.18 ; 95%CI: 0.86, 1.63 and < 2 glasses/d: OR: 1.54; 95%CI: 1.09, 2.15; P = 0.007). In the crude model drinking lower levels of water was associated with increased risk of anxiety in men (2-5 glasses/d: OR: 2.01; 95%CI: 1.20, 3.34 and < 2 glasses/d: OR: 1.83; 95%CI: 0.97, 3.43; P = 0.041) and in women (2-5 glasses/d: OR: 1.42 ; 95%CI: 0.98, 2.05 and < 2 glasses/d: OR: 1.59; 95%CI: 1.08, 2.34; P = 0.026); nevertheless, after adjustment for various confounders the significance associations disappeared in both genders.

DISCUSSION

In this analysis of a large cross-sectional study of general adults, lower daily plain water intake was associated with increased risk of depression and anxiety in the crude model. Although controlling for potential confounders attenuated these associations, the inverse link for depression remained strongly significant, whilst anxiety risk tended to be higher for lower water intake in the final model.

To our knowledge, this was the first investigation to examine the association of plain water consumption and common mental disorders, although the linkage of water/fluid consumption with obesity[6,12,24], coronary diseases[25], hyperglycaemia or diabetes[26,27], cancer[28] and mortality[29,30] has been examined in earlier studies. Some of these studies[6,12,24,25], but not all[26-30], confirm

Table 3 Multivariable-adjusted ORs (and 95%CIs) for depression and anxiety across categories of plain water consumption in the whole population and stratified by sex

	Plain water drinking			*P* trend[1]
	< 2 glasses/d	2-5 glasses/d	⩾ 5 glasses/d	
Depression				
Crude model	2.04 (1.62, 2.56)	1.39 (1.13, 1.71)	1 (reference)	< 0.0001
Model 1[2]	1.75 (1.35, 2.26)	1.30 (1.02, 1.64)	1 (reference)	< 0.0001
Model 2[2]	1.84 (1.37, 2.45)	1.39 (1.07, 1.80)	1 (reference)	< 0.0001
Model 3[2]	1.84 (1.40, 2.49)	1.41 (1.07, 1.84)	1 (reference)	< 0.0001
Model 4[2]	1.79 (1.32, 2.42)	1.37 (1.04, 1.80)	1 (reference)	< 0.0001
Anxiety				
Crude model	2.02 (1.46, 2.78)	1.73 (1.29, 2.32)	1 (reference)	< 0.0001
Model 1[2]	1.53 (1.07, 2.17)	1.44 (1.04, 1.99)	1 (reference)	0.026
Model 2[2]	1.58 (1.06, 2.36)	1.60 (1.11, 2.30)	1 (reference)	0.029
Model 3[2]	1.56 (1.03, 2.35)	1.63 (1.12, 2.40)	1 (reference)	0.066
Model 4[2]	1.49 (0.98, 2.25)	1.58 (1.08, 2.30)	1 (reference)	0.109
Men (n = 1386)				
Depression				
Crude model	1.77 (1.19, 2.63)	1.37 (0.99, 1.90)	1 (reference)	0.004
Model 1[2]	2.00 (1.26, 3.20)	1.45 (0.98, 2.13)	1 (reference)	0.003
Model 2[2]	1.95 (1.18, 3.21)	1.59 (1.06, 2.38)	1 (reference)	0.008
Model 3[2]	1.73 (1.02, 2.92)	1.54 (1.01, 2.36)	1 (reference)	0.037
Model 4[2]	1.73 (1.02, 2.93)	1.54 (1.00, 2.36)	1 (reference)	0.040
Anxiety				
Crude model	1.83 (0.97, 3.43)	2.01 (1.20, 3.34)	1 (reference)	0.041
Model 1[2]	2.36 (1.17, 4.74)	1.55 (0.87, 2.78)	1 (reference)	0.016
Model 2[2]	2.15 (1.02, 4.54)	1.59 (0.86, 2.95)	1 (reference)	0.042
Model 3[2]	1.76 (0.81, 3.84)	1.55 (0.82, 2.94)	1 (reference)	0.147
Model 4[2]	1.74 (0.80, 3.80)	1.52 (0.80, 2.88)	1 (reference)	0.161
Women (n = 1941)				
Depression				
Crude model	1.75 (1.30, 2.35)	1.26 (0.95, 1.67)	1 (reference)	<0.0001
Model 1[2]	1.61 (1.17, 2.21)	1.21 (0.90, 1.63)	1 (reference)	0.001
Model 2[2]	1.61 (1.16, 2.23)	1.21 (0.89, 1.65)	1 (reference)	0.002
Model 3[2]	1.61 (1.15, 2.26)	1.22 (0.89, 1.67)	1 (reference)	0.003
Model 4[2]	1.54 (1.09, 2.15)	1.18 (0.86, 1.63)	1 (reference)	0.007
Anxiety				
Crude model	1.59 (1.08, 2.34)	1.42 (0.98, 2.05)	1 (reference)	0.026
Model 1[2]	1.35 (0.89, 2.05)	1.41 (0.95, 2.07)	1 (reference)	0.264
Model 2[2]	1.39 (0.91, 2.13)	1.44 (0.97, 2.15)	1 (reference)	0.233
Model 3[2]	1.37 (0.88, 2.13)	1.44 (0.95, 2.18)	1 (reference)	0.288
Model 4[2]	1.30 (0.83, 2.02)	1.40 (0.92, 2.12)	1 (reference)	0.420

[1]Derived from a Mantel-Haenszel extension chi-square test; [2]Model 1: Adjusted for age, sex (in the whole population), marital status, educational level, model 2: Further adjustment for BMI, smoking, physical activity, model 3: Additional control for functional gastrointestinal disorders (FGID) and anti-psychotic medicines, model 4: Further control for magnesium, riboflavin, pyridoxine, folate, cobalamin, DHA and EPA, energy, fibre and caffeine. DHA: Docosahexaenoic acid; EPA: Eicosa pentaenoic acid.

the beneficial effects of water drinking in reducing diseases' risk. Therefore, due to bidirectional link between metabolic status and mental health[10], it might be concluded that water consumption can affect mental disorders risk *via* affecting metabolic status.

The bidirectional link between obesity and mental disorders is based on some shared peripheral and central pathological pathways, as well as genetic and environmental risk factors[10]. However, in line with some studies[26,31-33], we found that higher water consumption was associated with greater BMI. Therefore, some other plausible mechanisms may explain this inverse link. Our results indicate that higher water intake is associated with various healthy behaviours such as being more physically active and consuming greater amounts of nutrients particularly those involved in the nervous system (*e.g.*, riboflavin, magnesium, pyridoxine and cobalamin), which is consistent with previous studies[31,34]. Beneficial effects of these nutrients in neurotransmitters synthesis and transportation, as well as activity of many enzymes in the nervous system have been shown earlier[35,36]. Nevertheless, even after controlling for dietary intakes, depression was significantly related to water consumption, and anxiety tended to be higher in those who drank less water. A possible reason for the inverse link between water consumption and the risk of depression might be the decreased activity of the sympathetic nervous system by drinking water which reduces plasma levels of norepinephrine[37]. Elevated level of norepinephrine is a characteristic of psychosomatic depression[38] which may induce noradrenergic-vasopressinergic activation,

and consequently the activation of the hypothalamic-pituitary-adrenal (HPA) axis. Increased vasopressinergic activation of the HPA axis has been suggested as a plausible mechanism in all depressive disorders[38], which can be involved in mental symptoms production. In spite of similar link between water drinking and depression risk in men and women, the linkage for anxiety was stronger in men than women, though adjustment for antipsychotic medicines and FGIDs eliminated it. This difference between men and women might be related to sex-differences in the use of coping strategies[39]. However, the reasons for this difference are not clear and require further investigation.

In the current analysis, water consumption was evaluated using a direct question regarding the average amount of daily consumption of water, and data regarding other beverages intake and moisture contents of food were not considered. In addition, we provided predefined categories of plain water intake for participants. These factors may lead to misclassification of participants and decrease the reliability of our findings. However, it should be taken into account that noncalorically sweetened beverages are not public among Iranians and they are not used generally. Moreover, tea and coffee are mostly consumed with sugar. Therefore, since all other beverages, which consumed by this population, had calorie and we controlled the confounding effect of energy in our analysis, it could be concluded that our findings have enough precise. The consistence between our study's results and available evidence regarding the health beneficial of water intake might be further reason to confirm the accuracy of our findings.

The limitations of the current study are using self-administered questionnaires for evaluating the study variables. However, the validity of all used instruments has been approved among Iranians. Although using self-reported tools of habitual fluid/water intake is a common limitation in this area of research, the validity of self-reported measures has been approved in earlier studies[40,41]. In addition, no ideal method has been determined to assess beverage consumption and applying 24-h recall or frequency questionnaire beside a computer program on food composition is the existing recommend method in this regard[42]. The cross-sectional design is another limitation that does not allow causal inferences. Indeed, it is possible that individuals with mental disorders tend to drink less water. Nevertheless, such changes would have weakened the associations identified. Therefore, the true estimates are probably even stronger than those we found. Moreover, since we studied the participants who are staffs of IUMS, although they were not academic and medical experts, this sample may not be representative of the entire general population and therefore the results of our study may not be generalizable to other individuals in our society. The strengths of this study are the large sample size and controlling various confounders' effects.

In conclusion, we found inverse associations between plain water consumption and common psychological disorders. After controlling for various potential confounders, this association was stronger for depression, whilst for anxiety tended to be higher. These findings warrant evaluation in prospective studies to establish the plausible role of water in the mental health status.

ARTICLE HIGHLIGHTS

Research background

Drinking a plenty of plain water has been known as a healthy behavior.

Research motivation

The association between drinking water and mental disorders has not been investigated.

Research objectives

We aimed to assess whether drinking water is associated with mental disorders, and also examine the sex-specific associations.

Research methods

Three thousand three hundred and twenty-seven adults in a cross-sectional study were categorized into three groups according the amount of water drinking (< 2, 2-5, and ⩾ 5 glasses of water/d). The risk of depression and anxiety was evaluated across different categories.

Research results

After controlling for various potential confounders, we found inverse associations between plain water consumption and depression, whilst for anxiety tended to be significant. These findings warrant evaluation in prospective studies to establish the plausible role of water in the mental health status.

Research conclusions

There were inverse associations between plain water consumption and common psychological disorders.

Research perspectives

Prospective studies to establish the plausible role of water consumption levels in the mental health status are needed.

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SYSTEMATIC REVIEWS

Antidepressant foods: An evidence-based nutrient profiling system for depression

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Abstract

AIM

To investigate which foods are the most nutrient dense sources of nutrients demonstrated by the scientific literature to play a role in the prevention and promotion of recovery from depressive disorders.

METHODS

A systematic literature review was conducted to derive a list of Antidepressant Nutrients from the 34 nutrients known to be essential for humans using level of evidence criteria. Nutritional data was extracted for a subset of foods with a high content of at least 1 Antidepressant Nutrient using a USDA database. These foods were analyzed for Antidepressant Nutrient density resulting in an Antidepressant Food Score (AFS). Plant and animal foods were analyzed separately.

RESULTS

Twelve Antidepressant Nutrients relate to the prevention and treatment of depressive disorders: Folate, iron, long-chain omega-3 fatty acids (EPA and DHA), magnesium, potassium, selenium, thiamine, vitamin A, vitamin B6, vitamin B12, vitamin C, and zinc. The highest scoring foods were bivalves such as oysters and mussels, various seafoods, and organ meats for animal foods. The highest scoring plant foods were leafy greens, lettuces, peppers, and cruciferous vegetables.

CONCLUSION

The AFS is based on a nutrient profiling system devised to identify foods with the highest nutrient density of nutrients with clinical evidence to support their

role in depressive disorders. This list of foods and food categories with the highest density of the 12 Antidepressant Nutrients, the Antidepressant Foods, should be considered by researchers in the design of future intervention studies and clinicians as dietary options to support prevention and recovery from depression disorders.

Key words: Depressive disorder; Mental disorders; Diet; Diet therapy; Food

Core tip: The Antidepressant Food Score was designed to identify the most nutrient-dense individual foods to prevent and promote recovery from depressive disorders and symptoms. Results can be used to inform the design of future research studies or clinical dietary recommendations. This tool is based on a systematic literature review, evidence-informed list of Antidepressant Nutrients, and nutrient density calculation. The highest scoring animal foods were bivalves such as oysters and mussels, various seafoods, and organ meats. The highest scoring plant-based foods were leafy greens, lettuces, peppers, and cruciferous vegetables. These foods can be integrated into any dietary pattern.

LaChance LR, Ramsey D. Antidepressant foods: An evidence-based nutrient profiling system for depression. *World J Psychiatr* 2018; 8(3): 97-104 Available from: URL: http://www.wjgnet.com/2220-3206/full/v8/i3/97.htm DOI: http://dx.doi.org/10.5498/wjp.v8.i3.97

INTRODUCTION

Mental illnesses are highly prevalent, disabling, costly, and inadequately treated. Among individuals aged 15-44, depressive disorders are the leading cause of disability worldwide[1]. Improving public awareness and increasing treatment options for psychiatric illnesses is imperative to public health. A growing evidence base, including the first randomized controlled trial[2], suggests that dietary pattern and food choice may play a role in the treatment and prevention of brain-based disorders, particularly depression. The first nutritional guidelines to prevent depression were published this year. They recommend following a traditional dietary pattern such as the Mediterranean diet, consuming adequate amounts of omega-3 fatty acids, and avoiding processed foods, for example those high in refined carbohydrate or sugar[3]. Furthermore, an international consortium of mental health and nutrition researchers recently recommended "nutritional psychiatry" become a routine part of mental health clinical practice[4].

A number of nutrients are implicated in the patho-physiology of depression, for instance: the long-chained omega-3 fatty acids, B-vitamins, zinc, magnesium, and vitamin D[5,6]. Deficiencies of these nutrients can cause depressive symptoms, and in supplement form are used in clinical treatment[7-9]. Recent literature on nutrition and psychiatry has shifted from studying individual nutrients to evaluating overall dietary patterns. Prospective epidemiological studies have repeatedly found that "traditional" or "whole foods" dietary patterns are significantly correlated with a decreased prevalence and incidence of depressive disorders or symptoms. A Western dietary pattern has been found to be associated with an increased relative risk of the same[4,10-12]. The SUN cohort study followed 10094 university students for 4 years and found those with the highest adherence to the Mediterranean dietary pattern (MDP) showed a greater than 30% reduced risk of developing depression over the study period compared with participants with the lowest adherence to the Mediterranean dietary pattern[13]. Studies of traditional diets in Japan, Norway, and China found similar results[14-16]. A systematic review and meta-analysis of whole-diet interventions for depression and anxiety symptoms attempted by Opie *et al*[17] found the heterogeneity of the studies precluded analysis. However, among the 47% of studies that found a positive impact of a dietary intervention, common recommendations were to increase consumption of fruit, vegetables, fiber, and fish[17]. Dietary counselling used as an active control in a trial of problem-focused therapy for the prevention of depression in 122 elderly adults with sub-syndromal depressive symptoms, found a significant and sustained 40% reduction in Beck Depression Inventory scores at two years in participants who received 5.5 h of food counselling over 6-12 wk[18]. The SMILES (Supporting the Modification of Lifestyle in Lowered Emotional States) trial, the first randomized controlled trial of a dietary intervention to treat major depressive disorder, found that prescribing a modified Mediterranean diet as an adjunctive treatment resulted in 31% achieving remission compared with placebo and a number needed to treat of 4.1[19].

Brain health and mental illness are impacted by nutrition *via* several mechanisms. A full discussion is beyond the scope of the current paper, though we would like to highlight a few relevant mechanisms here. Nutrients such as the long-chained omega-3 fatty acids, zinc, magnesium, and a number of phytonutrients promote the expression of Brain Derived Neurotropic Factor (BDNF) and thus influence neuroplasticity[20]. Additionally, food is a modifiable determinant of systemic inflammation, which has been described as a major cause and consequence of depression according to the neuroinflammatory hypothesis of this disorder[21]. Finally, the emerging role of gut flora (*i.e.,* the microbiome) as a possible key player in the regulation of mood, cognition, and anxiety suggests that we are only beginning to discover the potential of food as medicine[22]. Dietary fiber is a prebiotic and its consumption can alter the composition of the microbiota[22].

Table 1 Levels of evidence

Levels of evidence: Observational studies	Levels of evidence: Experimental studies
1. At least 2 prospective cohort studies with adequate sample size and/or meta-analysis with narrow confidence intervals	1. At least 2 RCTs with adequate sample sizes, preferably placebo-controlled, and/or meta-analysis with narrow confidence intervals
2. At least 1 prospective cohort study with adequate sample size and/or meta-analysis with wide confidence intervals	2. At least 1 RCT with adequate sample size and/or meta-analysis with wide confidence intervals
3. Cross-sectional or case control studies	3. Non-randomized, controlled prospective studies (open-label) or high-quality retrospective studies (*i.e.*, case series)
4. Expert opinion/consensus	4. Expert opinion/consensus
5. Evidence is equivocal/unavailable	5. Evidence is equivocal/unavailable

RCT: Randomized controlled trial.

There are inherent challenges in prescribing a dietary pattern that is foreign to an individual. A Japanese or MDP may not be practical or palatable for many patients. Instead, ranking foods and highlighting food categories with a high density of nutrients demonstrated to be beneficial for depression could lead to specific food recommendations that can be incorporated into a whole-foods dietary pattern of the patient's choosing[3]. For the purpose of the current paper, nutrient density is defined as the ratio of a foods' nutrient value to its caloric content.

A review of 23 existing nutrient profiling schemas found them to be oriented towards improving a number of health outcomes. While many nutrient profiling scales currently exist, created by government agencies, researchers, and the food industry, none focus on mental disorders or brain health[23]. Additionally, no scale is based on nutrients that are supported by scientific literature to be involved in the prevention of and recovery from psychiatric disorders. The objective of this study is to determine which foods are the most nutrient dense sources of nutrients demonstrated by human studies published in the current scientific literature to play a role in the prevention and promotion of recovery from depressive disorders.

MATERIALS AND METHODS

A list of 34 essential nutrients for humans was compiled based on the Institute of Medicine's Dietary Reference Intakes[24]. A reference librarian at Columbia University was consulted to develop a systematic search strategy to further refine an evidence-based list of Antidepressant Nutrients. Computerized searches of OVID Medline, Embase, and Embase Classic dating back to 1946 were conducted during February 2017 using the search terms "Depressive Disorder, Major (MeSH)" and "Depression (MeSH)" in combination with the following nutrients: Arsenic, biotin, boron, calcium, carotenoids, choline, chromium, copper, dietary fiber, fluoride, folic acid, iodine, long chain omega-3 fatty acids (docosahexanoic acid and eicosapentanoic acid), magnesium, manganese, molybdenum, niacin, nickel, phosphorus, potassium, pyridoxine, riboflavin, selenium, sodium, silicon, sulfates, vanadium, vitamin A, vitamin B12, vitamin C, vitamin E, vitamin K, and zinc. Search terms were adapted to different databases. Titles and abstracts were read by both of the study authors to determine if retrieved papers were relevant to the topic under study according to the following inclusion criteria: Observational or experimental studies of an essential nutrient for the treatment or prevention of depressive disorders or symptoms (unipolar) in humans. Exclusion criteria included non-English language articles, review articles, and opinion pieces. Next, nutrient by nutrient, relevant articles underwent full-text review and data extraction by both study authors. Study findings were coded as positive, negative, or equivocal in regard to the prevention or recovery from depressive disorders. Discrepancies were resolved by both authors *via* consensus.

Statistical analysis

A system to rank the level of evidence in support of each potential antidepressant nutrient was developed based on level of evidence criteria used in various clinical practice guidelines in psychiatry[25]. The level of evidence was established for both observational and experimental human studies for each nutrient under consideration using the following guidelines shown in Table 1. Nutrients were included in the list of Antidepressant Nutrients if they had a combined score of less than or equal to 5. For example, magnesium received a total score of 4. There was one positive RCT and one positive prospective cohort study, both with adequate sample sizes, resulting in a level of evidence score of 2 for both experimental and observational studies.

Lists of the top 20 plant and animal whole food sources of each Antidepressant Nutrient were compiled in July 2017 based on the USDA nutrient database[26]. After duplicates were removed, this preliminary list consisted of 213 foods. An additional 23 commonly recommended healthy foods such as whole wheat, blueberries, and yogurt were added to this list to assess their AFS.

The nutrient content for each Antidepressant Nutrient was gathered using the database for each of the 236 foods. Nutrient content was expressed as a percent daily value. When percent daily values were not available, such as for long chain omega-3 fatty acids, we extracted the absolute nutrient amount per 100 g raw serving. This was then later converted to a percent daily value. For

Table 2 Antidepressant foods

Antidepressant animal foods	AFS range	Antidepressant plant foods	AFS range
Oyster	56%	Watercress	127%
Liver and organ meats (spleen, kidneys, or heart)	18%-38%	Spinach	97%
Poultry giblets	31%	Mustard, turnip, or beet greens	76%-93%
Clam	30%	Lettuces (red, green, romaine)	74%-99%
Mussels	28%	Swiss chard	90%
Octopus	27%	Fresh herbs (cilantro, basil, or parsley)	73%-75%
Crab	24%	Chicory greens	74%
Goat	23%	Pummelo	69%
Tuna	15%-21%	Peppers (bell, serrano, or jalapeno)	39%-56%
Smelt	20%	Kale or collards	48%-62%
Fish roe	19%	Pumpkin	46%
Bluefish	19%	Dandelion greens	43%
Wolffish	19%	Cauliflower	41%-42%
Pollock	18%	Kohlrabi	41%
Lobster	17%	Red cabbage	41%
Rainbow trout	16%-17%	Broccoli	41%
Snail or whelk	16%	Brussels sprouts	35%
Spot fish	16%	Acerola	34%
Salmon	10%-16%	Butternut squash	34%
Herring	16%	Papaya	31%
Emu	16%	Lemon	31%
Snapper	16%	Strawberry	31%

AFS: Antidepressant food score.

long chain omega-3 fatty acids, we based this calculation on a recommended daily intake of 1000 mg of long chain omega-3 fatty acids (EPA + DHA) based on a review of available guidelines[27].

Data was gathered for a 100 g serving of each food in the raw form. This was done because various cooking methods can alter the nutrient content, nutrient bioavailability, and water content of foods. In addition, nutrients vary largely with respect to bioavailability and form between plant and animal foods. For instance, heme-iron is only found in animal foods, and with the exception of certain sea vegetables, long chain omega-3 fatty acids are not found in plant foods. Separating plant and animal foods also served to minimize heterogeneity in bioavailability and content of nutrients across foods.

The mean Antidepressant Nutrient density was calculated for each food included in our list. This generated a nutrient density score, which was expressed as a percentage. The percent daily value for each nutrient was capped at 100% so that one nutrient would not overly influence the AFS. Our methods were adapted from a recent nutrient profiling study of "powerhouse" fruits and vegetables[28]. The following formula was used to calculate the Antidepressant Food Score: [(Σ % daily value per Antidepressant Nutrient / 12) / calories per 100 g serving] × 100.

RESULTS

Literature review

Our initial searches resulted in 1628 results and screening by title and abstract resulted in 213 relevant results eligible for full-text review. The following 12 nutrients met level of evidence criteria and were considered Antidepressant Nutrients: Folate, iron, long chain omega-3 fatty acids (EPA, DHA), magnesium, potassium, selenium, thiamine, vitamin A, vitamin B6, vitamin B12, vitamin C, and zinc.

Antidepressant food score

The top Antidepressant Foods based on the AFS are displayed in Table 2. Foods were grouped into categories and ranked in Table 3. Grouping foods into categories serves to ease implementation of results by providing the researcher or clinician with more flexibility[29]. The complete list of foods analyzed, Antidepressant Nutrient content per 100 g serving, AFS, and level of evidence per nutrient are displayed in the Supplementary Materials. The authors excluded the following 6 foods from analysis, as data was not available for greater than two nutrients: whale liver, caribou liver, blackfish, boar, antelope, and longan.

DISCUSSION

To our knowledge, The Antidepressant Food Score (AFS) is the first nutrient profiling system created to inform dietary recommendations concerning mental health. This evidence-based approach is unique in that it is based on Antidepressant Nutrient density. That is, nutrients considered have been shown in human studies to be beneficial with regards to treatment or prevention of depressive disorders. Our findings include a list of individual foods as well as food rankings within categories that can be incorporated in the design of subsequent research studies or recommended to patients as part of a healthy dietary pattern of their choosing.

Table 3 Food categories and mean antidepressant food score

Food category	Mean AFS
Vegetables	48%
Organ meats	25%
Fruits	20%
Seafood	16%
Legumes	8%
Meats	8%
Grains	5%
Nuts & seeds	5%
Dairy	3%

AFS: Antidepressant food score.

Interestingly, many foods with a high AFS are not commonly eaten as part of the Western dietary pattern. Specifically, the majority of the United States adult population does not meet daily recommendations for vegetables. The Healthy People 2010 initiative aimed to increase vegetable consumption of adults and found that only 27.2 percent ate three of more servings of vegetables per day[30]. Average annual seafood intake for Americans is 14.6 pounds, and the USDA estimates that 80-90 percent of the population fails to meet the recommendation of two servings of seafood per week[31]. On the contrary, top scoring foods on the AFS; seafood, leafy greens, cruciferous vegetables, and nuts are commonly consumed as part of a variety of traditional diets. The Mediterranean dietary pattern is but one example of a consistent pattern: traditional diets contain more nutrient dense foods and fewer highly processed foods. The evidence linking dietary patterns and depressive disorders supports the consumption of a whole-foods based traditional diet as opposed to a Western dietary pattern to prevent and promote recovery from depression. This emerging literature provides some external validity to the results of the AFS while our study serves to identify what some of the "active ingredients" of these traditional diets may be.

Selecting foods based on nutrient density is one way to meet daily nutrient requirements without consuming excessive calories, which may have benefits beyond mental health[32]. This is particularly important considering that a number of Antidepressant Nutrients have high rates of dietary insufficiency, meaning many individuals do not meet the Recommended Dietary Allowance (RDA). For example, 55% of the American population does not meet the RDA for vitamin A, 75% for folate, and 68% for magnesium[33].

It is worth discussing how our results differ from certain currently accepted dietary guidelines and nutrient profiling systems[28,32,34]. For instance, the AFS is focused on depression and does not consider dietary constituents to avoid such as saturated fat, cholesterol, and sodium. A recent review suggests that nutrient profiling scales designed to improve consumer food choices should be based on nutrients known to be beneficial for health as opposed to nutrients to avoid[29]. Moreover, the harmfulness and potential benefit of nutrients such as saturated fat, cholesterol, and sodium for both physical and mental health is being called into question based on more recent research, and cholesterol is no longer considered a nutrient of concern according to the most recent Dietary Guidelines for Americans[35-37]. Lastly, the AFS only ranks whole, unprocessed foods free of added sodium and fats. Recommending that patients continue to avoid fat, cholesterol, and sodium can potentially steer them away from consuming entire potentially nutritious food categories, such as seafood.

Certain nutrients, such as long-chain omega-3 fats, vitamin B12, and heme-iron are only found in animal foods such as seafood, meat, eggs, and dairy and these foods are generally absent from existing nutrient profiling scales. This may occur because a certain scale incorporates dietary cholesterol, saturated fat, or sodium as nutrients to avoid while others simply omit animal foods entirely. As health recommendations have trended towards more "plant-based" diets, one must consider the higher rates of B vitamin deficiencies in both vegetarian and vegan populations. A recent large study found higher levels of depressive symptoms in vegetarian men[38]. Our findings highlight the importance of including animal foods as an important part of a healthy dietary pattern to prevent and promote recovery from depressive disorders. That being said, there is a divergence between the animal foods that score highly on our scale such as organ meats and seafoods, and the processed meats typically consumed as part of the Western dietary pattern. The results of our study add to the current discussion in the nutrition literature about the importance of "plant based" diets by presenting a complimentary recommendation: Consuming animal products such as seafoods, organ meats, and small amounts of other traditionally-raised minimally processed meats is an important part of a healthy diet for depression. This is relevant as the majority of eaters consume animal products.

Gut health is increasingly understood as critical for brain health[22]. Along with being nutrient-dense sources of vitamins and minerals, two components of plants are relevant to mental health, but not well represented in the literature: fiber and phytonutrients. Generally, fiber is lacking in Western diets, and this influences the population and diversity of bacterial species that comprise the microbiome, the collection of bacteria that reside in the gut[39]. Phytonutrients are plant-based compounds, such as lycopene and quercetin, that are traditionally thought of as "antioxidants" but play clear cell signaling roles that influence genetic expression and modulate inflammation[40]. Ranking foods by phytonutrients content was not feasible, nor is there sufficient evidence linking individual phytonutrients to brain health. Fiber did not reach our level of evidence cutoff for inclusion and clearly more studies are needed.

The AFS ranks foods and nutrients with an established dietary reference intake included in the USDA database for standard reference at the time of analysis. Our

determination of Antidepressant Nutrients was based on the currently available scientific literature based on our search strategy at the time of our literature searches. As such, certain nutrients such as phytonutrients and other antioxidants were automatically excluded from our algorithm either based on a lack of established dietary reference intake, lack of inclusion in the USDA database, or lack of human studies supporting their effectiveness in treating or preventing depressive disorders. Finally, clinical trials of nutrients often use doses of supplements far beyond those possible *via* food consumption. If a high dose of vitamin B12 can promote depression recovery, it does not necessarily follow that foods with high nutrient density of vitamin B12 do as well.

Findings from the current study can be incorporated into the design of subsequent research studies. For instance, in developing a dietary intervention for depression, researchers should consider including and emphasizing foods that score highly on the AFS. Furthermore, upon publication of the current paper, the authors plan to make our database publicly available online for use by clinicians, researchers, and patients alike. Next steps also include expanding our database to include all foods listed in the USDA database.

In conclusion, a nutrient profiling system focused on mental health yielded rankings of plant and animal foods according to nutrient density of the 12 nutrients supported by current evidence: Folate, iron, long chain omega-3 fatty acids (EPA, DHA), magnesium, potassium, selenium, thiamine, vitamin A, vitamin B6, vitamin B12, vitamin C, and zinc. Evidence-informed dietary recommendations are critical to the employment of nutritional psychiatry in clinical practice. Considering cost, stigma, and access, nutritional interventions provide a unique treatment opportunity for mental health patients. Additionally, mental health professionals are well versed in supporting behavioral changes, of which dietary change is simply an example. As the evidence-base for nutrition as a modifiable factor influencing both the risk and prognosis of mental illness continues to expand, the AFS is a tool to help researchers refine nutritional recommendations to inform the design of future studies and to help clinicians guide patients towards healthier food choices today.

ARTICLE HIGHLIGHTS

Research background

The Western dietary pattern is insufficient in a number of essential nutrients. Evidence suggests dietary pattern is key to the prevention and treatment of depressive disorders, yet treatment rarely includes food recommendations. Nutrient profiling systems rank foods according to nutrient density and guide clinical recommendations, research study design, and patient choices. No current food rating scale focuses on nutrients required for mental health.

Research objectives

The objective of this study is to determine which foods are the most nutrient dense sources of nutrients demonstrated by the scientific literature to play a role in the prevention and promotion of recovery from depressive disorders.

Research methods

A systematic literature review was conducted to derive a list of Antidepressant Nutrients from the 34 nutrients known to be essential for humans using level of evidence criteria. Nutritional data was extracted for a subset of foods with a high content of at least 1 Antidepressant Nutrient using a USDA database. These foods were analyzed for Antidepressant Nutrient density resulting in an Antidepressant Food Score (AFS). Plant and animal foods were analyzed separately.

Research results

Twelve Antidepressant Nutrients relate to the prevention and treatment of depressive disorders: Folate, iron, long-chain omega-3 fatty acids (EPA and DHA), magnesium, potassium, selenium, thiamine, vitamin A, vitamin B6, vitamin B12, vitamin C, and zinc. The highest scoring foods were bivalves such as oysters and mussels, various seafoods and organ meats for animal foods. The highest scoring plant foods were leafy greens, lettuces, peppers, and cruciferous vegetables.

Research conclusion

The AFS is based on a nutrient profiling system devised to identify foods with the highest nutrient density of nutrients with clinical evidence to support their role in depressive disorders. This list of foods and food categories with the highest density of the 12 Antidepressant Nutrients, the Antidepressant Foods, should be considered by researchers in the design of future intervention studies and clinicians as dietary options to support prevention and recovery from depression.

Research perspectives

The AFS was designed to identify the most nutrient-dense individual foods to prevent and promote recovery from depressive disorders and symptoms. Results can be used to inform the design of future research studies or clinical dietary recommendations. This tool is based on a systematic literature review, evidence-informed list of Antidepressant Nutrients, and nutrient density calculation. The highest scoring animal foods were bivalves such as oysters and mussels, various seafoods, and organ meats. The highest scoring plant-based foods were leafy greens, lettuces, peppers, and cruciferous vegetables. These foods can be integrated into any dietary pattern.

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LETTERS TO THE EDITOR

Psychic euosmia and obsessive compulsive personality disorder

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Abstract

Patients with obsessive compulsive personality disorder (OCPD) often refer to a prompt mood improvement upon encountering good scents in general, or fresh laundry borax on their clothes, pillows or home settings. The Authors propose the new term psychic euosmia in the mean of an overstated psychological predisposition for a real pleasant smell that elicits an immediate sense of pleasure, order and calm. The prompt reactions to a pleasant odor might be explained by the involvement of rhinencephalon and its proximity to mood-related limbic circuits, which bypass the cognitive awareness. Cleanliness may not preclude a subject to enjoy a good smell, even if we are representing smells that resemble freshness, in other words order. A potentially even more important argument is given by the continuum of personality disorders and their variability. Not all personality characteristics led to disturbed behaviors. In evolutionary perspectives having the ability to differentiate between unpleasant and pleasant odors should have made the difference in surviving. On the other hand, psychic euosmia could be considered a normal reaction, but in our clinical experience it is over-represented among OCPD subjects with marked orderliness and disgust. Therefore, detecting psychic euosmia might vicariously confirm the relevance of disgust as a cognitive driver of OCPD. Hereby we support research to characterize psychic euosmia as a feature of orderliness and cleanliness for OCPD.

Key words: Psychic euosmia; Obsessive compulsive personality disorder; Orderliness; Pleasure; Positive emotion; Pesonality

Core tip: Patients with obsessive compulsive personality disorder (OCPD) often refer to a prompt mood improvement upon encountering good scents in general,

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TO THE EDITOR

Pierre Janet, in his conceptualization of obsessions and compulsions, described an inability to achieve perfection[1]. This phenomenon characterizes both obsessive compulsive personality disorders (OCPD) and OCD. Available literature indicates that two main factors of OCPD, order/control and hoarding/indecision, were identified among OCPD patients[2]. Hyper-control and orderliness, cleanliness other than perfectionism are often awkward and dysfunctional in these subjects. Yet, OCPD manifestations are generally considered ego-syntonic and are perceived by affected individuals as appropriate and correct. In many OCPD subjects perfectionism does not represent a maladaptive variant as a rule. In any case, there are several effects of orderliness behaviors that result in an underrated emotion of pleasure, even thought subjects are aware of its pathological nature. This is the case of a peculiar manifestation of orderliness. Clinicians involved in the treatment of OCPD are aware of how their patients often refer to a prompt mood improvement upon encountering good scents in general, or fresh laundry borax on their clothes, pillows or home settings. In medical terminology parosmia is defined as an olfactory dysfunction to properly identify an odor's "natural" smell, while euosmia is a form of parosmia in which a neutral odor is transcribed into a pleasant odor. Here we refer to psychic euosmia in the mean of an overstated psychological predisposition for a real pleasant (not neutral) smell that elicits an immediate sense of pleasure, order and calm. It could be seen as the opposite reaction of irritability of sensory experiences called misophonia[3]. For OCPD patients, congenial odors resemble a sensation of freshness, not simply an essence or perfume.

Some may argue that this is exactly the counterpart of chaos, of disgust, that was associated to contamination and moral purity. Disgust-sensitivity is a well-know framework in cognitive models of OCD, but it fits to OCPD too, perhaps better. From a biological perspective unpleasant odors activate insula and caudate[4]. More, enlarged gray matter volume of the left medial orbital gyrus was found by using the Sniffin' Sticks test[5]. The prompt reactions to a pleasant odor might be explained by the involvement of rhinencephalon and its proximity to mood-related limbic circuits, which bypass the cognitive awareness.

To our knowledge there are no studies regarding neurobiological abnormalities or clinical aspects that investigate the correlates of psychic euosmia in OCD and OCPD subjects. As an explanation in mental health, researchers and clinicians are automatically looking at pathological aspects of phenomena. In his nonconforming paper Bentall stressed that psychopathologists tautologically are not concerned about elation and joy[6] Hence we posit that a pathological issue, as an overrepresented psychic euosmia, should not have a positive emotional consequence in reason of being pathological *per se*. Thus, cleanliness may not preclude a subject to enjoy a good smell, even if we are representing smells that resemble freshness, in other words order. A potentially even more important argument is given by the continuum of personality disorders and their variability. Not all personality characteristics led to disturbed behaviors. In this way, having OCPD traits could be not dysfunctional at all, and many individuals with OCPD traits deal with head positions in their activities. In evolutionary perspectives having the ability to differentiate between unpleasant and pleasant odors should have made the difference in surviving[7]. On the other hand, psychic euosmia could be considered a normal reaction, but in our clinical experience it is over-represented among OCPD subjects with marked orderliness and disgust. Therefore, detecting psychic euosmia might vicariously confirm the relevance of disgust as a cognitive driver of OCPD. Hereby we support research to characterize psychic euosmia as a feature of orderliness and cleanliness for OCPD.

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