

# Mal de Debarquement

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**Objectives:** To better define *mal de débarquement* (“sickness of disembarkment”) syndrome, to understand the etiology or mechanism of this disorder, and to seek better prevention and treatment options for this disorder.

**Design:** Patient survey of clinical features.

**Setting:** Participants were recruited via advertisement in the newsletter of the Vestibular Disorders Association, Portland, Ore.

**Patients:** Twenty-seven individuals with mal de débarquement syndrome were identified. To be included in the study, patients must have experienced at least 1 month of rocking or swaying following a cruise or airplane trip of at least 4 hours in duration.

**Intervention:** A questionnaire was administered.

**Main Outcome Measure:** Clinical features of mal de débarquement syndrome.

**Results:** Nearly all respondents were middle-aged women (26 of 27; mean age, 49.3 years). The duration of symptoms ranged from 6 months to 10 years (mean, 3.5 years; SD, 2.5 years). The symptoms were constant in 23 (85%) patients. Neither meclizine hydrochloride nor transdermal scopolamine was helpful. Benzodiazepines were of the most benefit. Balance rehabilitation physical therapy was undertaken by 15 patients, who on average reported a small benefit.

**Conclusions:** More than double the number of previously reported cases of mal de débarquement syndrome were identified by this study. The syndrome usually occurs in middle-aged women following an ocean cruise. Symptoms are often refractory to vestibular suppressants as well as physical therapy.

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**M**AL DE DEBARQUEMENT (MDD), literally “sickness of disembarkment,” refers to inappropriate sensations of movement after exposure to motion. The syndrome typically follows a sea voyage, but similar sensations have been described following extended train travel, space flight,<sup>1</sup> and experience within a slowly rotating room.<sup>2</sup> Symptoms usually include vague unsteadiness and disequilibrium or sensations of rocking and swaying, but not rotational vertigo. Mal de débarquement is distinguished from motion sickness, airsickness, simulator sickness, or seasickness (*mal de mer*) because subjects are predominantly symptom free during the period of motion. Mal de débarquement is distinguished from “land-sickness” or postmotion vertigo by duration. Landsickness typically lasts less than 48 hours.<sup>3,4</sup> We, like most others reporting on MDD,<sup>5-7</sup> define it almost exclu-

sively as a syndrome that persists for at least 1 month. Some authors<sup>4</sup> refer to the common short-lived postmotion vertigo as MDD, and the longer duration form as “persistent MDD.”

To our knowledge, only 20 subjects with MDD as defined above have been described in the literature.<sup>5-7</sup> However, this syndrome is probably more common than the literature<sup>7</sup> might lead us to believe. We undertook a patient survey to better define MDD, to understand the etiology or mechanism of this disorder, and to seek better prevention and treatment options.

## RESULTS

The 26 women and 1 man ranged in age at onset of symptoms from 35 to 72 years, with a mean age of 49.3 years (SD, 10.3 years). The age distribution is shown in **Figure 1**. Fifteen (56%) subjects were between the ages of 40 and 49 years at the time of onset of MDD, with only 3 (11%)

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## SUBJECTS AND METHODS

A 12-page questionnaire was distributed to subjects solicited through the Vestibular Disorders Association, Portland, Ore, newsletter in 1996. The circulation of the newsletter at that time was 6000, and approximately 70% of subscribers were women. Persons in whom a diagnosis of MDD was made by at least 1 physician were solicited. They were also required to meet our criteria for MDD, which included a sensation of rocking or swaying that persisted for at least 1 month following a 4-hour or longer exposure to motion on an airplane or boat. A total of 35 individuals responded, of whom 30 met these criteria, including 3 who did not have a prior physician diagnosis but whose questionnaire responses indicated probable MDD. We excluded 3 respondents in whom perilymphatic fistula, prior stapes surgery, and a brainstem stroke were diagnosed, leaving a total of 27 subjects for inclusion in this study.

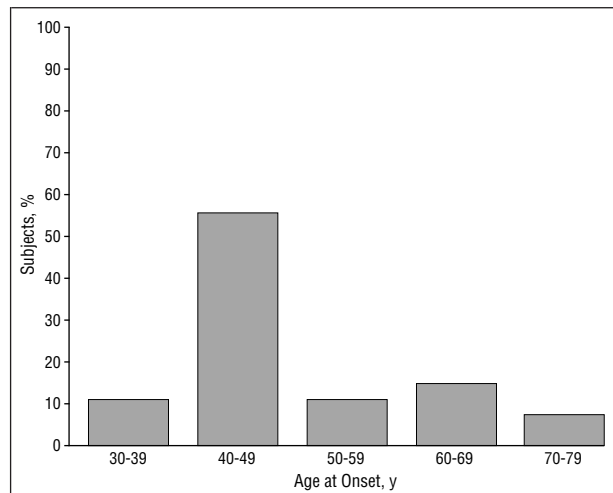
The questionnaire asked for demographic information, symptoms, onset and provoking factors, and treatment for the MDD, as well as questions regarding specific ear problems, previous injuries, lifestyle, family history, medical history, headaches, medical tests, and a general medical review of systems. It also included the Dizziness Handicap Inventory (DHI).<sup>8</sup> The questionnaire responses were reviewed to determine eligibility, and data from key questions were entered into a computer spreadsheet. The DHI was scored, and this score was also entered into the spreadsheet.

The data were analyzed using a statistics package (SPSS, Chicago, Ill). Parametric and nonparametric inferential statistics were used, as appropriate, and included Pearson correlation, Spearman  $\rho$  correlation, independent group  $t$  test, and the Mann-Whitney  $U$  test when the assumption of homogeneity of variance for the  $t$  test was violated. The criterion for statistical significance was set at  $P \leq .05$ , 2-tailed test.

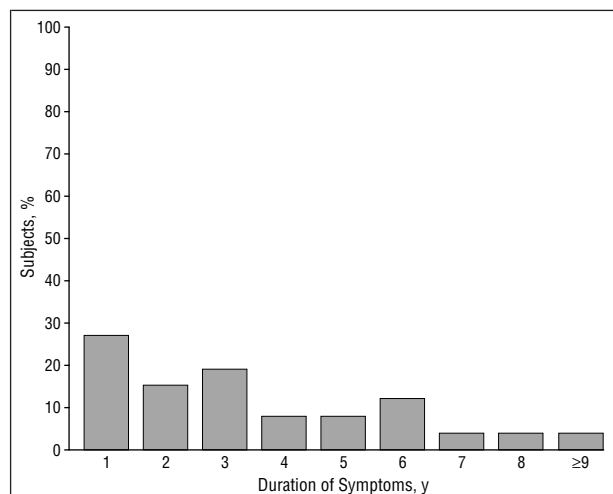
being younger than 40 years. Twenty-five subjects were white, and 2 were Hispanic. Of the 25 subjects for whom menopausal status was known, 13 (52%) were premenopausal, 3 (12%) were perimenopausal, and 9 (36%) were postmenopausal, with 7 of the 12 perimenopausal or postmenopausal subjects receiving hormone replacement therapy. In other words, 20 (80%) of our female subjects were either premenopausal or receiving hormone replacement therapy. None of the subjects were pregnant at the time of onset of symptoms. Twenty-five subjects had onset of symptoms after boat travel ( $\geq 5$ -day ocean cruise in 21, 2-day riverboat trip in 1, 1-week river barge trip in 1, and 5-day lake house boat trip in 1) and 2 after airplane travel ( $\geq 4$  hours).

### SYMPTOMS

The mean duration of symptoms at the time of the survey was 3.5 years (SD, 2.5 years), with a range from 1



**Figure 1.** Age at onset of mal de débarquement syndrome, in decades (mean, 49.3 years; SD, 10.3 years).



**Figure 2.** Duration of mal de débarquement symptoms at time of survey (mean, 3.5 years; SD, 2.5 years).

to 10 years (**Figure 2**). Symptoms were constant in 23 (85%) patients, and intermittent in the remaining 4 (15%). Subjects were asked to check which of a list of specific symptoms they currently have. Results are shown in **Table 1**, with symptoms ordered from most to least common. Rocking (in 25 [93%] subjects) and swaying (in 22 [81%]), of course, occurred in most subjects. Imbalance was also common (in 20 [74%] subjects). About half of the subjects also reported "tilting" and "ear symptoms." Nausea and headache each occurred in about 9 (33%) subjects. Vertigo was relatively rare (found in 3 of 27 subjects). Of the 14 symptoms on the list, all subjects reported more than 1, with a median of 5 symptoms; and 21 (78%) reported more than 3 symptoms. The number of symptoms reported was significantly negatively correlated with the duration of the disease ( $r = -0.52$ ,  $P \leq .007$ ) and was not related to age at onset ( $r = .006$ ,  $P > .05$ ). We further explored these data by comparing duration and age at onset between subjects with and without those symptoms for which there was some distribution of occurrence,

including nausea, headache, ear symptoms, imbalance, and tilting. Again, there was no evidence that age at onset was related to presence of any given symptom. However, duration of disease was significantly shorter in those subjects reporting headache (mean, 1.9 years; SD, 1.2 years) than in those without headache (mean, 4.4 years; SD, 2.6 years) ( $U=30.0, P\leq.01$ ) and in those subjects with tilting (mean, 2.4 years; SD, 2.0 years) than in those without tilting (mean, 4.8 years; SD, 2.5 years) ( $t=2.67, P\leq.01$ ).

Although only 15 (56%) of the subjects checked ear symptoms as part of their present illness, 24 (89%) described having experienced otologic symptoms at some time since the onset of MDD when asked about specific ear problems. Otologic symptoms reported by 26 survey subjects follow:

Symptom	No. (%) of Patients
Fullness	19 (73)
Tinnitus	18 (69)
Hyperacusis	16 (61)
Otalgia	11 (42)
Decreased hearing	10 (39)

Although 8 subjects had been exposed to loud noises in the past and 1 had undergone a mastoid procedure at the age of 6 years, the remainder did not report previous otologic problems. Like the other symptoms, the number of ear symptoms reported (of the 5) correlated negatively with duration of disease ( $\rho=-0.42, P\leq.03$ ). The number of ear symptoms also correlated positively with the total number of other symptoms ( $\rho=0.47, P\leq.01$ ).

Six (23%) of 26 subjects met the International Headache Society criteria for migraine,<sup>9</sup> and migraine headache was diagnosed in 5 of them. This figure is similar to the 20% prevalence of migraine found in 50-year-old women in the general population.<sup>10</sup> Eight additional subjects described recurring headaches at some point in their lifetime, although they did not meet formal International Headache Society criteria. Only one subject had a headache on the cruise or flight that preceded the MDD.

## DISABILITY

Disability from the symptoms of MDD was assessed using the DHI. The DHI is scored from 0 to 100, with 0 being no disability and 100 being the highest level of disability. The mean DHI score for the 26 subjects who completed it was 45.6 (SD, 20.8), with a range from 4.0 to 84.0. Similar to the number of symptoms, the DHI score was negatively correlated with duration of disease ( $r=-0.46, P\leq.02$ ). It was also positively related to the total number of symptoms reported ( $r=0.49, P\leq.01$ ). Subjects reporting headache tended to have a higher (worse) disability score than those without headache, but the difference did not achieve statistical significance ( $P\leq.09$ ). However, those with imbalance did have a significantly higher DHI score (mean, 49.8; SD, 10.9) than those not reporting imbalance as a symptom (mean, 24.2; SD, 6.4) ( $U=32.0, P\leq.05$ ). Eight (31%) of 26 subjects reported a change in their occupational status as a result of MDD.

**Table 1. Symptoms of Mal de Debarquement in 27 Survey Subjects**

Symptoms	No. (%)
Rocking	25 (93)
Swaying	22 (81)
Imbalance	20 (74)
Ear symptoms	15 (56)
Tilting	14 (52)
Nausea	10 (37)
Headache	9 (33)
Jumping vision	6 (22)
Blurred vision	5 (19)
Perioral tingling	4 (15)
Spinning (vertigo)	3 (11)
Diplopia	1 (4)
Vomiting	1 (4)
Other*	3 (11)

\* Includes eye twitch, fuzzy-headed/woozy, and pulling/numbness in foot or lower leg.

## ONSET AND PROVOKING FACTORS

For the 21 individuals who had taken cruises, there was no obvious pattern with regard to cabin location; 16 had a window in their cabin. Seven subjects had used some sort of motion sickness prevention medication: 5 used scopolamine patch, 1 used meclizine hydrochloride, and the remaining person did not recall what she had used. Only 8 subjects described experiencing rough waters. Twenty took an airplane trip shortly after the cruise, and one participated in scuba diving during the trip.

There was a family history of dizziness in 4 subjects, and of migraine in 12. A history of neck injury was reported in 3 subjects; head injury preceding the onset of MDD by at least 2 months was noted in 7; and 11 believed that they were highly stressed. Only 3 smoked tobacco-containing products.

**Table 2** shows reported provoking factors. Twenty-three subjects (88%) described increased symptoms just after further motion exposure, such as flights, car rides, or boat rides. Symptoms were also increased by anxiety and stress (in 21 [81%]), positional changes (in 19 [73%]), rapid head movement (in 17 [65%]), and various other factors (including visual stimuli, forms of movement, food or drink, and environmental conditions). (Data are based on 26 respondents.)

## TREATMENT

Subjects were asked an open-ended question about whether, in the history of their condition, they had found anything that lessened the symptoms, including medications. Symptoms were reported to be alleviated while driving in 17 subjects (63%) and by other movement in 7 (26%). Considering medications, benzodiazepines were of most benefit, with clonazepam being helpful in 3 of 6 subjects, diazepam in 2 of 10 subjects, and alprazolam in 1 of 4 subjects. Other medications tried, and their success rate, were amitriptyline hydrochloride (2 of 7 subjects); methazolamide (1 of 1 subject); a combination of acetaminophen, caffeine, and butalbital (Fioricet) (1 of 1

**Table 2. Factors Provoking MDD Symptoms\***

Factors	No. (%)
Airplane, boat, or car travel	23 (89)
Anxiety or stress	21 (81)
Positional changes	19 (73)
Rapid head movement	17 (65)
Malls, open or narrow places	17 (65)
"Busy" designs or window blinds	16 (61)
Walking in the dark	13 (50)
Reading	11 (42)
Loud noises	11 (42)
Elevators, escalators	11 (42)
Standing up	10 (39)
Alcohol	10 (39)
Menstruation	10 (39)
Exercise	9 (35)
Not eating	9 (35)
Sudden changes in weather	9 (35)
Time of day, particular seasons	9 (35)
Driving a car, boat, plane	6 (23)
Blowing nose, sneezing, straining	6 (23)
Caffeine	5 (19)
Heat	5 (19)
Sugar or sweet foods	4 (15)
Other†	8 (31)

\*MDD indicates *mal de débarquement*. Data are based on 26 respondents.

†Salt/salty foods (*n* = 2), eating (*n* = 1), monosodium glutamate (*n* = 1), and other foods (*n* = 4).

subject); nitrous oxide (1 of 1 subject); a combination of oxycodone hydrochloride and acetaminophen (Percocet) (1 of 1 subject); morphine (1 of 1 subject); and lorazepam (0 of 2 subjects). Neither meclizine nor scopolamine was helpful (0 of 17 and 0 of 12 subjects, respectively). Fifteen subjects had balance rehabilitation (9 of these took medication during the therapy), and 10 of them reported benefit. Average benefit attributed to rehabilitation was 1.7 on an analog scale ranging from much worse (score, -5), to no benefit (score, 0), to much better (score, 5).

### COMMENT

We report detailed survey information on 27 subjects with persistent MDD. All but one subject was female, with a typical age at onset in the 40s. The mean duration of symptoms at the time of the survey was 3.5 years, with nearly 8 (30%) of the subjects having had symptoms for 5 years or more. Onset usually followed boat travel, typically an ocean cruise. In general, MDD followed passive motion—none of our subjects was the driver or otherwise controlled the prolonged motion that immediately preceded the onset of symptoms. For most subjects, symptoms were constant (in 23 [85%]) and included rocking (in 25 [93%]), swaying (in 22 [81%]), imbalance (in 20 [74%]), and tilting (in 14 [52%]). Nausea and/or headache occurred in about 9 (33%) of the respondents, but rotational vertigo was uncommon. All but 3 of the subjects also reported 1 or more otologic symptoms, including tinnitus, fullness, hyperacusis, earache, and hearing loss. The rate of these complaints seems high compared with the general population, particularly given the age distribution of the subjects, and was significantly re-

lated to the number of MDD symptoms. With these exceptions, MDD occurs mainly in persons who are otherwise in good health.

The number of symptoms as well as the presence of several particular symptoms was negatively related to duration of disease. The longer the time since onset, the fewer the symptoms and the less likely was the presence of headache or tilting. This would suggest that despite the long-term nature of MDD in these subjects, it might continue to diminish with time. The number of otologic symptoms was also negatively related to duration of MDD. The DHI disability rating for the group was related to the number of symptoms and to the presence of certain symptoms such as imbalance and headache. The DHI score was also negatively correlated with duration since onset of symptoms.

Literature describing persons with persistent MDD is sparse. Brown and Baloh<sup>5</sup> reported 6 cases of MDD in 1987. They noted that despite anecdotal reference to this syndrome, there had been no published definition or description. Five of their 6 subjects were women, ranging in age from 38 to 71 years. Five of the subjects developed MDD after boat travel, with durations of exposure that varied from less than 5 hours to 70 days. Subjects typically experienced little relief from antivertiginous medication. Three subjects exhibited a direction-changing positional nystagmus during electronystagmography. The results of caloric testing were normal in all subjects. One patient had abnormally prolonged optokinetic after nystagmus, but the authors did not indicate whether this response was tested in all patients. Brown and Baloh suggest that MDD syndrome is caused by an abnormally persistent central nervous system adaptation to the seagoing environment that causes a failure or delay of re-adaptation to the earth-stable environment.

Murphy<sup>6</sup> reported 4 additional cases of MDD. All of these were women, ranging between 36 and 48 years of age. The duration of motion exposure ranged from 8 hours to 7 days, and the duration of symptoms between 4 weeks and 1 year. Three subjects developed MDD after exposure to water travel; and the remaining patient developed MDD after sleeping on a water bed. One patient had direction-changing positional nystagmus. Amitriptyline was helpful in one patient, and lorazepam in another. Murphy suggests that the sensations described by subjects are consistent with a perception of abnormal linear acceleration, and that, because the utricle is known to be responsible for responding to linear acceleration, MDD syndrome may result from "utricle dysfunction." He notes hormonal interaction with the vestibular system or brain, and/or inability of the brain to coordinate vestibular and ocular input as other possible causes.

Most recently, Mair<sup>7</sup> reported 10 cases of MDD. Again, all subjects were female, with ages ranging from 15 to 66 years. Sea travel provoked symptoms in 8, and air travel in 2. Onset followed exposure varying from 2 hours to 2 days, with all but 1 less than 18 hours. While one patient had symptom duration of only 3 days, all others had symptoms persisting for at least 1 month, ranging up to 2 years. Mair suggested that defective or delayed re-adaptation following cessation of motion may be an important causative factor. He also noted that sex

differences have been previously shown to exist in susceptibility to motion sickness and in the degree to which visual cues are used for orientation.

Other researchers have reported that a large percentage of persons disembarking from seagoing voyages experience a brief MDD syndrome, which by our definition would instead be termed landsickness. Gordon et al<sup>11</sup> surveyed 234 healthy crew members of seagoing vessels. They reported a high incidence of a short-lived MDD symptom complex (73%). Presumably, most of their subjects were men. As a follow-up to that study, Gordon et al<sup>4</sup> studied 116 male crew members of seagoing vessels. The subjects ranged in age from 18 to 33 years and sailed once or twice a week. Seventy-two percent reported having experienced MDD. The duration of symptoms ranged from 1 minute to 2 days, lasting less than 6 hours in 88% of the men. They found a significant relationship between susceptibility to seasickness and the occurrence of MDD.

None of the subjects in the study by Gordon et al<sup>4</sup> would qualify as having MDD according to our criteria. Similarly, Cohen<sup>3</sup> recently studied professional and amateur crew members participating in sailing on a 117-year-old sailing vessel. Her sample included 36 men and 23 women. After the first sailing day, 37% reported landsickness symptoms, which increased to 41% after the second day, and then decreased to 20% after further experience. Men and women did not differ significantly in the incidence, intensity, or duration of symptoms. Cohen noted that this might be due to the lack of a true sex difference or to the fact that the sensations experienced by her subjects were relatively benign. Cohen also noted that women may seek medical assistance more readily than men, and that this may account for some sex difference findings.

Our study population was solicited from members of a vestibular support group, whose members are approximately 70% women. Yet, given the consistency of the 3 studies<sup>3-7</sup> on MDD, it would appear that although landsickness may be common in both sexes following motion exposure, it is more likely to persist and become MDD in women. This has some implications regarding possible causes.

## POTENTIAL ETIOLOGIC FACTORS IN MDD

### Migraine

The prevalence of migraine is estimated at 11% of the general population, and about 20% in women during their reproductive years.<sup>12</sup> Migraine has a similar female predominance at the age of 50 years (3:1) when compared with MDD and occurs most commonly at the age of 35 years. Migraine has been strongly associated with motion sensitivity.<sup>13</sup> From our data, 6 (22%) of the subjects fit the International Headache Society criteria for migraine, with another 8 (30%) having recurring headaches. However, only one patient had a migraine on the MDD-provoking voyage, and, in most of the subjects, the headaches have resolved. Studying a large group of subjects with migraine for MDD syndrome could help clarify the findings.

## Hormones

There is a strong predominance of women in studies of MDD and a relatively narrow age group. In our study, only about one third were postmenopausal, and none were premenarchal, suggesting that female hormones may facilitate this syndrome. Murphy<sup>6</sup> noted the age and female predominance in his subjects (4 of 4) and also postulated a hormonal effect. Based on this same evidence, one could also hypothesize that MDD is somehow related to factors biologically dependent on the presence of 2 copies of the X chromosome. On the other hand, landsickness clearly occurs in a large percentage of men after ocean voyages. These issues could be clarified by obtaining more data in this age group, studying men who are taking estrogen (eg, for control of prostate cancer), and studying MDD in large groups.

### Inner Ear Pathology (Ménière Disease)

The symptoms of these subjects are clearly not consistent with Ménière disease. Although many have tinnitus and perhaps hearing loss, they do not typically experience attacks of rotational vertigo, which is one of the defining hallmarks of Ménière disease. Because the present study is based on patient survey, we do not have any vestibular or auditory test data.

### Persistent Central Nervous System Adaptation to the Seagoing Environment

Although reasonable, we cannot clearly address such a theory within the limitations of our survey study. Mal de débarquement syndrome does not have the features of a pathological disease, in the sense that it does not appear to follow an injury. Rather, it is provoked by exposure to motion that does not trouble most individuals, at least not in a persistent manner. While the appearance of a rocking sensation as a result of adaptation might seem implausible, as it implies the initiation of an oscillating pattern, experimentally a pendular nystagmus lasting up to 60 minutes can be induced in rabbits by 24 hours of exposure to torsional or parallel swing stimuli.<sup>14</sup>

### Psychogenic Cause

Mal de débarquement does not appear to have a psychogenic basis. Brown and Baloh<sup>5</sup> note that the relatively late age at onset as well as the lack of other medical complaints is not supportive of a somatization disorder. Our findings were similar. The extreme female predominance also is not consistent with a psychogenic cause, which is generally more evenly distributed according to sex.

## TREATMENT

The fact that the participants in our study were drawn from members of a vestibular support group who are likely to have severe or refractory symptoms may have biased our results in a pessimistic way. In general, one might consider treatments aimed at preventing MDD and treat-

ments aimed at ameliorating the effects of MDD once it has occurred. We know of no studies to date regarding prevention of MDD through medication. If MDD is indeed related to inappropriate vestibular adaptation, medications that slow such adaptation (vestibular suppressants such as benzodiazepines) might be tried. Certainly, for persons with a history of MDD, avoidance of further prolonged exposure to rocking motion seems prudent.

For treatment of an ongoing MDD syndrome, there is evidence from our survey of a positive effect of benzodiazepines and amitriptyline. Meclizine and scopolamine were entirely ineffective. Finally, Brown and Baloh,<sup>5</sup> Murphy,<sup>6</sup> and Mair<sup>7</sup> all recommend vestibular rehabilitation or exercise for the MDD syndrome. Our findings document only a limited response to vestibular rehabilitation. In addition to vestibular rehabilitation therapy, a procedure aimed at accelerating adaptation, medications that speed adaptation (eg, stimulants, such as amphetamines) might be tried. To our knowledge, these medications have not been studied for MDD.

### CONCLUSIONS

In summary, persistent MDD is a prolonged sensation of rocking, swaying, imbalance, or other motion typically triggered by a seagoing voyage. The disorder appears to occur almost exclusively in women, with age of onset typically in the 40s. The cause is unclear. Symptoms usually diminish with time, but can last for years. More work is required to obtain a greater understanding of this little-known disorder. An increased awareness among physicians may help lead to the clinical knowledge necessary to develop effective treatment strategies.

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