

# Sleep-related Injury in the Elderly—An Epidemiological Study in Hong Kong

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**Objectives:** Sleep-related injury is a serious but under-recognized condition. We examined the occurrence of sleep-related injuries and REM sleep behavior disorder (RSBD) in a community sample of elderly in Hong Kong.

**Design:** A representative sample of elderly aged 70 years or above were interviewed with a screening question on the presence of sleep-related injuries. Those who answered affirmatively as well as a subsample of negative responders were interviewed by clinicians. Patients with suspected sleep disorders underwent physical and psychiatric assessment as well as sleep studies.

**Setting:** NA

**Patients or Participants:** NA

**Interventions:** NA

**Results:** In total, 1034 elderly were surveyed and 0.8% reported history of sleep-related injury. Four subjects were confirmed to have RSBD, giving an estimated prevalence of RSBD of 0.38% (95% CI=0.01 to 0.76%). One subject had suspected RSBD but refused investigations while 1 had history suggestive of transient RSBD but could not be confirmed by the sleep studies. The course of RSBD in these subjects was that of a waxing and waning course instead of a progressive deterioration as described in previous literature. Two patients had been hospitalized for sleep-related injury before but their sleep disorder was not recognized.

**Conclusions:** We found that sleep-related injury and RSBD were not rare in the elderly but were frequently under-recognized. Our study calls for greater attention to elderly who had sustained injury during sleep.

## INTRODUCTION

SLEEP-RELATED INJURY IS A SERIOUS BUT PROBABLY UNDER-RECOGNIZED PHENOMENON. Its exact prevalence in the community is still unknown and there are only a few studies on this condition. Schenck et al. studied 100 cases of nocturnal injuries presenting to a sleep disorder unit and found that night-terrors/sleepwalking were the most common cause followed by REM-sleep behavior disorder.<sup>1</sup> Less common causes included dissociative disorders, nocturnal seizures, and sleep apnea.<sup>1</sup>

A recent study in the general population by telephone interview with a standardized instrument by lay interviewers reported that 2.1% had violent behavior during sleep.<sup>2</sup> REM sleep behavior disorder (RSBD) was estimated to be present in 0.5% of the general population.<sup>2</sup> However, a major limitation of this study is the lack of clinical evaluation as well as polysomnographic studies.

RSBD is a recently described parasomnia characterized by a history of excessive nocturnal motor activities and absence of muscle atonia during REM sleep.<sup>3</sup> The present-

ing features are usually vigorous sleep behavior in the presence of vivid dreams which may lead to repeated injuries to the patients and/or their bed-partners.<sup>4</sup> Serious injuries leading to ICU admission have also been reported.<sup>5</sup> Diagnosis of the condition relies on a typical history together with polysomnographic abnormalities of excessive augmentation of chin EMG tone or limb twitching during REM sleep.<sup>4</sup>

From the few studies published so far, it appears that RSBD affects predominantly males, with an approximate male to female ratio of 9:1.<sup>6</sup> It occurs more often in the elderly and the mean age of onset in a group of 70 patients presenting to a sleep disorder clinic is 52.6 years.<sup>6</sup> Both transient and chronic forms of RSBD have been described.<sup>4</sup> The exact prevalence of RSBD is unclear as there has never been any epidemiological study in the community with confirmation by sleep studies. We now report a study on the occurrence of sleep-related injuries and RSBD in a community sample of elderly, aged 70 or above, in Hong Kong. This study is part of a community survey on the prevalence of dementia and depression in the elderly which has been approved by the local Ethics Committee.

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## SUBJECTS AND METHOD

Hong Kong has a population of 6.2 million, 96% of whom are ethnic Chinese. The survey was conducted in the second half of 1995 in the Shatin district of Hong Kong. The general population of Shatin is around 569,000 and there are about 28,100 elderly, aged 70 and above. This study is part of a project to examine the prevalence of mental disorders in Chinese elderly in Hong Kong. Detailed methodology has been published in another article.<sup>7</sup> In brief, a representative sample of elderly (aged 70 and over) living in Shatin were interviewed. In Hong Kong, there is no satisfactory register of elderly in the population like the general practitioner's list, or the Electoral Roll, and the best available register is the list of old age allowance and disability allowance recipients. This list covers over 90% of all elderly in Hong Kong (aged 70 and over) and was used as the sampling frame of this study. Subjects were recruited by a stratified random sampling from this register. The stratification was according to age and sex so that there would be approximately 150 subjects in the 70–74 and 75–79 age groups for each sex, and 100 in the 80–84, 85–89 and 90+ age groups for each sex.

### Procedures

A two-stage design was used to examine the frequency of sleep-related injury in this elderly population. In Phase 1, subjects were informed of the study and their consent was obtained by the Social Welfare Department. Subjects who had agreed to be interviewed were then visited at home by trained interviewers. The face-to-face interview consisted of a questionnaire on the demographic data, medical history, and sleep habits of the subject. A screening question was used to detect sleep-related injury (SRI) as follows: "Have you ever inflicted injuries to yourself or other people during your sleep?" which could be answered yes or no. In addition, the Cantonese versions of the Minimal State Examination<sup>8</sup> (CMMSE) and the Geriatric Depression Scale<sup>9</sup> were administered. If the elderly had difficulty in answering the SRI question due to cognitive impairment, the relative or care taker was asked to supply the information.

In Phase 2, all subjects who had a positive response to the SRI question were interviewed by experienced psychiatrists. Apart from these subjects, elderly scoring below the cut-off point on the CMMSE,<sup>7</sup> as well as those with scores in the depressed range on the CGDS (8 or above), were also interviewed as part of another project on the prevalence of dementia and depression in elderly in Hong Kong. Cut-off points for cognitive impairment were chosen according to the findings of a previous study: 18 or below for illiterate subjects, 20 or below for those with one to two years of schooling, and 22 or below for those with more than 2 years of schooling.<sup>7</sup> In addition, a random sample of 6% of

the elderly who had a score in the normal range on both the CGDS and the CMMSE and negative response to the SRI question were also interviewed. Whenever possible, relatives or bed-partners were also interviewed.

Subjects whose clinical history was suggestive of underlying sleep disorders underwent comprehensive psychiatric, physical, and neurological examination. In addition, they were invited to undergo overnight polysomnographic studies with video recording in our sleep assessment unit. Polysomnographic monitoring included electro-oculogram, EEG, electromyogram (chin, bilateral anterior tibialis muscle, and bilateral extensor digitorum muscle), ECG, nasal oral airflow, and respiratory movements. The polysomnographs were scored according to Rechtschaffen and Kales' criteria<sup>10</sup> and read blindly by an experienced polysomnographic technologist and confirmed by a psychiatrist experienced in sleep medicine. Diagnosis of RSBD was made according to the criteria of Mahowald and Schenck:<sup>4</sup> 1) history of problem sleep behavior that is harmful or potentially harmful, or disruptive of sleep continuity or annoying to self or bed-partner; and 2) polysomnographic abnormality of either excessive augmentation of chin EMG tone or excessive chin or limb EMG twitching during REM sleep.

### RESULTS

The effective target sample was 1,503 after excluding subjects who had died, moved away from Shatin, or wrong addresses were recorded. Of these, 1,034 (68.8%) were successfully interviewed. Among the rest, 428 (28.5%) refused to be interviewed, 29 (1.9%) could not be contacted, and 12 (0.8%) were too deaf or physically too ill to be interviewed. In Phase 1, there was no significant difference in the age ( $\chi^2=2.114$ ;  $df=4$ ;  $p=0.715$ ) and sex ( $\chi^2=0.00092$ ;  $df=1$ ;  $p=0.98$ ) of the non-respondents compared with the respondents. Among the interviewed subjects, 176 (17.0%) were living in old age homes or care and attention homes (similar to nursing homes); 12.6% of the elderly were living alone.

Out of the 1,034 elderly interviewed in Phase 1, 34 (25 of whom had dementia) could not answer if they had SRI and their relative or care taker could not supply the information. Ten had a positive response to the SRI question, while 307 had a score above the cut-off point of the CGDS or below the cut-off of the CMMSE (among these patients, one had a positive response to the SRI question as well as a score in the depressed range). In addition, 44 subjects were randomly selected out of the remaining subjects who had scores within the normal range on both the CGDS and CMMSE and a negative response to the SRI question for further examination. Out of these 360 subjects, 341 were successfully interviewed in Phase 2, including all 10 subjects with a positive response to the SRI question.

After clinical interview in Phase 2, 6 subjects out of the 10 with a positive response to the SRI question had clinical

history suggestive of RSBD. They all had history of acting out their dreams. As for the remaining four subjects with a positive response to the screening question, two were false positives, since they had misunderstood the question and did not really have a history of sleep-related injury on further evaluation. One subject with chronic obstructive airway disease sustained injury during a fall when he went to the toilet at night. The final subject had only one episode of sleep-related injury three years prior to the survey, but had no history suggestive of any underlying sleep disorders and the exact cause could not be determined. Thus eight subjects (0.77%) had SRI. In contrast, none of the remaining of subjects interviewed in Phase 2 had features suggestive of SRI.

Out of the six subjects with features suggestive of RSBD, 1 refused further investigation by sleep studies, but was clinically diagnosed as probable RSBD. The remaining five subjects with suspected RSBD participated in the overnight sleep studies and four were confirmed to have RSBD. The fifth subject's history was suggestive of transient RSBD. His wife was punched by him on the chest while he was dreaming of fighting with others once five years ago. However, sleep studies over two nights did not

show RSBD features. None of these subjects had EEG features suggestive of complex partial seizure. Table 1 summarizes the clinical data of these patients.

For the four patients who underwent overnight sleep recording, all had increase in tonic EMG activity during REM sleep. The mean percentage of atonia during REM sleep was  $32 \pm 17\%$  for these patients according to the scoring method described by Lapierre and Montplaisir.<sup>11</sup> Three of the four patients with RSBD had behavioral manifestation recorded during REM sleep including vocalization, gesticulation, searching or fussy movements, and aggressive behavior.<sup>12</sup>

Thus three elderly males and one elderly female had confirmed RSBD, giving an estimated prevalence of 0.38% (95% CI=0.01 to 0.76%) of chronic RSBD. If the patient with probable RSBD who refused investigation was included, the rate was 0.48%. If the patient with transient RSBD was also included, the rate would be 0.58%. The duration of RSBD of the four confirmed cases ranged from 5 to 10 years (Table 1). In all four subjects, the course of RSBD was such that it got worse over a number of years and then became static for a few years. Subsequently, it became more infrequent and less severe instead of taking a relent-

**Table 1**—Clinical data of patients with confirmed and suspected RSBD

Sex/Age	Duration	Injuries during sleep	Physical problems	Sleep disorder diagnosis & treatment
M/88	8–9 yrs	Repetitive falls from bed, with repetitive mild head injury (hospitalized once); observed to have an episode of "sleepwalking"	Gout, osteoarthritis of knee, hernia	Confirmed RSBD & OSAS; CNZ 1mg & CPAP, good response
F/81	10 yrs	bruises over limbs/head; frequent falls from bed; used mattress on floor for protection	No significant illness	Confirmed RSBD; responded well to CNZ 1mg
M/74	5 yrs	Frequent bruises; observed to have several episodes of "sleepwalking"	Parkinson's disease for 7 years	Confirmed RSBD; on madopar & CNZ 0.5mg, good response
M/70	10 yrs	Fell from bed repeatedly; head injury and fracture of cheekbone with hospitalization once; used mattress on floor; punched wife several times	Pneumoconiosis	Confirmed RSBD; refused treatment
M/81	transient	Punched wife once 5 yrs ago while dreaming of fighting with enemies, wife sustained bruise and was treated by herbalist; no self injuries	Benign prostatic hypertrophy	Sleep studies did not show RSBD; probably transient RSBD
M/76	2 yrs	Punched wife once 2 yrs ago and once 1 yr ago while dreaming of fighting with others; no self injuries	No significant illness	Refused sleep studies; probably mild RSBD

CNZ—clonazepam

OSAS—Obstructive sleep apnoea syndrome

CPAP—continuous positive airway pressure

less progressive course. Their clinical picture was very similar to that reported in the literature, (i.e., talking, shouting and excessive movements during sleep, changed nature of dreams which became very vivid and accompanied by dream-enacting motor activities, as well as injuries sustained during sleep). Two patients had sustained head injury resulting in hospitalization. Falling from bed during sleep as reported by three patients. Two patients were observed by informants to have "sleepwalking." Protective measures were used by two patients who put a mattress on the floor. All four subjects reported their subjective sleep quality to be good. None of the patients thought that their sleep problem was an illness, although two of them felt ashamed of their sleep disturbance. Medically, one patient had Parkinson's disease and dysthymic disorder while one had pneumoconiosis. One patient was found to have mild obstructive sleep apnea syndrome (OSAS) in the sleep studies while the fourth had no significant illness. The patient with OSAS was treated with continuous positive airway pressure (CPAP) which improved the sleep apnea but not his RSBD. Three subjects were treated with clonazepam for RSBD, with good response. All had no further SRI after treatment and their sleeptalking, shouting and limb movements were markedly decreased. However, one subject with RSBD refused treatment.

## DISCUSSION

To the best of the authors' knowledge, this is the first study on the prevalence of sleep-related injury and RSBD in an elderly population in the Hong Kong community. The strength of this study is that a two-phase design was employed and was followed by detailed sleep studies. As shown in our study, not all who responded positively to the screening question had SRI, and of those with SRI, the most common cause is related to RSBD.

Our study shows that injurious behavior occurring during sleep is not rare in the elderly population, being found in 0.8% of subjects. The only other study in the literature reporting on violent or injurious behavior during sleep in the general population reported that 2.1% of subjects exhibited such behavior.<sup>2</sup> In that study, violent behavior during sleep was associated with sleeptalking, sleep starts, bruxism, obstructive sleep apnea syndrome, and psychiatric disorders. Studies of nocturnal injuries presenting to sleep disorders unit showed that night-terrors/sleepwalking are the most common cause.<sup>1</sup> However, both of these conditions are not common in the elderly population and may account for their absence in our sample.

Mahowald and Schenck had proposed diagnostic criteria of RSBD, which included either history of problem sleep behavior and any polysomnographic abnormalities or no history of sleep behavior but with polysomnographic abnormalities and videotaped behavioral abnormality.<sup>4</sup> Recently there is some controversy surrounding the speci-

ficity of absence of atonia in the diagnosis of RSBD since intermittent absence of atonia may be present in subjects without any sleep complaint as well as in patients with neurodegenerative disease.<sup>11,13</sup> Some authors have suggested that the diagnosis of RSBD should be made only when there is persistent tonus and complex motor behavior during REM sleep.<sup>11,13</sup> However, the exact percentage of REM time with tonic chin EMG activity to be used as the criteria of RSBD would need to be studied further.<sup>11,13</sup>

Pending the further refinement of diagnostic criteria of RSBD, we used the criteria by Mahowald and Schenck,<sup>4</sup> which had been widely used in previous studies. All our patients with RSBD had a history of problem sleep behavior and polysomnographic abnormalities. Further, as our patients were identified from the community, they might provide information that supplemented data gathered from clinic samples reported in the literature on those who were likely to be the most severe cases.

Chronic RSBD was confirmed in 0.4% of this elderly sample. If we include the patient with features suggestive of RSBD who refused investigations, the rate of chronic RSBD would rise to 0.48%. This is very similar to the finding of Ohayon et al.'s study, which reported a rate of 0.5% in the general population.<sup>2</sup> Nevertheless, these figures are likely to be underestimates as some elderly may not know they have injurious behavior during sleep and their relatives or care takers may not know this either. In addition, some elderly are reluctant to reveal injurious behavior during sleep as they may feel embarrassed. For instance, two of our subjects with RSBD were ashamed of their sleep problem. More importantly, subjects with mild RSBD, who did not have SRI, would not be detected in our study. It is conceivable that there is a group of subjects with mild RSBD who only have sleeptalking and excessive movements during dream enactment but without any SRI. Thus, the actual rate of RSBD in the community is likely to be higher than what we found. Further, cases with transient RSBD might be missed as patients might not recall the SRI. In addition, these cases might not be detected by sleep studies after the patient had recovered from RSBD, as illustrated by one of our subjects whose history was suggestive of transient RSBD.

Our finding of four confirmed cases of RSBD out of 1,034 elderly in the community suggests that it is not a rare condition. Nevertheless, it is probably a hidden morbidity in the community due to under-recognition as suggested by the finding that none of the four patients with RSBD and their relatives thought that this type of sleep problem was an illness or sought medical help. Two of our subjects with RSBD had been hospitalized for head injury but the underlying sleep disorder had not been recognized. Indeed, RSBD is a potentially dangerous condition leading to various injuries, including head injuries and fractures to the patients,<sup>4</sup> as well as violence to the bed-partners.<sup>14</sup> Yet it is

readily responsive to drug treatment as demonstrated by our patients. Our study calls for greater attention to the elderly sustaining injury at night or during sleep.

In the four subjects with chronic RSBD, only one patient had an associated neurological condition while the other three had idiopathic RSBD. This is consistent with the findings in previous studies that at least half of the cases are idiopathic.<sup>4</sup> Surprisingly, no demented patients were found to have SRI even though we have included patients with dementia in our sample, as dementia was known to be associated with RSBD.<sup>4</sup> This might be due to impaired recall by demented patients as well as a low level of vigilance by their care takers regarding SRI. Thus it is possible that we might have missed some elderly with dementia who had SRI. The presence of obstructive sleep apnea syndrome in one of the patients with RSBD is an interesting finding. As the patient had been treated with CPAP without any improvement in his RSBD, it suggests that the OSAS may not have any direct etiological role in his RSBD.

In most cases of RSBD reported in the literature, patients usually had a progressive course. By contrast, the course of RSBD in our patients identified in the community was that of a waxing and waning one in the absence of treatment. This may suggest that those seen in sleep clinics are the more severe ones while the natural course for patients in the community is not as relentlessly progressive as initially thought. In addition, our study lends support to the male predominance of RSBD as well as good response to clonazepam reported in previous studies.<sup>4,6</sup>

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