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Original article

Actigraphic daytime activity is reduced in patients with cognitive impairment and apathy

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ABSTRACT

Objectives: Apathy is a neuropsychiatric symptom in mild cognitive impairment (MCI) and dementia. This study examines correlations between Apathy Evaluation Scale (AES) ratings and actigraphic measures of daytime activity. The aim of this study is to determine the value of ambulatory actigraphy in the assessment of locomotor deficits as a correlate of apathy in geriatric patients with cognitive impairment.
Patients and methods: In this cross-sectional study a total of 82 participants were recruited, 32 patients with dementia, 21 patients with MCI and 23 elderly controls. Rating scales for apathy (AES) and depression (Beck Depression Inventory, BDI) were completed. To measure daytime activity a wrist-worn actigraph and an established protocol were used. A single measure of mean daytime activity per participant was calculated for further statistical analysis.
Results: In the two groups of patients with MCI and dementia, apathy is associated with reduced daytime activity, independent of diagnosis (no group by apathy interaction). AES scores correlate significantly with daytime activity. Cognitive impairment reduces daytime activity (effect greater in dementia than in MCI). Daytime activity is negatively correlated with memory deficits.
Conclusion: Ambulatory actigraphy is a promising method to evaluate self-initiated action as a correlate of apathy in patients with cognitive impairment.

1. Introduction

Robert Marin defined apathy as the "simultaneous diminution in the cognitive and emotional concomitants of goal-directed behaviour" [14]. Apathy is a common finding in patients with dementia, neuropsychiatric disorders and other medical problems [10,15,17]. Different subtypes of apathy can be attributed to disturbed arousal, executive deficits and impaired social awareness [23]. When untreated, apathy accounts for poor functional outcome [11,17]. Apathy is a major diagnostic and therapeutic problem in old age psychiatry and neuropsychiatry. In many patients symptoms of apathy overlap or co-exist with symptoms of depression and motor symptoms of neurological diseases [15]. Robert et al. proposed diagnostic criteria for apathy in Alzheimer's disease and other neuropsychiatric disorders [21]. Clinical studies normally use the Apathy Evaluation Scale (AES) [2,7,15] or the apathy sub-scale of the Neuropsychiatric Inventory (NPI) [4] to assess the severity of apathy.

Ambulatory actigraphy with a commercially available wrist-worn actigraph is an observer-independent method that has been used to investigate limb and body movements in participants with hypo- and hyperactivity syndromes [5,12,16]. It was associated with findings of reduced daytime activity (DtA) in participants with fronto-temporal dementia (FTD) and disturbed sleep–wake cycles in participants with moderate-to-severe Alzheimer's disease. Circadian disruptions were associated with cortisol profiles but not with the severity of dementia [9]. This study used ambulatory actigraphy in participants with dementia and mild cognitive impairment (MCI) to determine the value of ambulatory actigraphy in the assessment of locomotor deficits as a correlate of apathy. Correlations between reduced DtA and increased apathy were predicted.

2. Methods

2.1. Participants

A total of 149 subjects were asked to participate in this study. All participants were aged 65 or older at enrolment. Most participants were recruited among local nursing home residents

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and among persons who had previously participated in a geriatric fall prevention study. To decrease possible confounders concerning actigraphic measurement of daytime activity, we defined exclusion criteria on which potential participants were excluded at baseline visit. Eleven subjects were excluded because of a current medication with cholinesterase inhibitors, 32 subjects because of the intake of antipsychotic, sedative or antidepressant drugs. Eight subjects were excluded because of major psychiatric disorders or movement disorders such as tremor, hyperkinesias, akinesia, plegia or immobilization. In three subjects there were no adequate actigraphy data to calculate mean daytime movement, and three further patients with evidence of disturbances in sleep-wake pattern were excluded from further analysis. Sixteen subjects declined to participate in this study for a variety of reasons.

We included a total number of 76 (51,0%) subjects (10 men/66 women), 21 patients with mild cognitive impairment, 32 patients with dementia (Alzheimer's disease according to the NINCDS-ADRDA criteria or vascular dementia according to the NINDS-AIREN criteria) and 23 subjects without evidence of cognitive impairment participated in this study.

The study was approved by the ethics committee of Ulm University (application nr. 50/07) and all participants gave written informed consent.

2.2. Ambulatory actigraphy

To measure daytime activity, a wrist-worn actigraph (Actiwatch Mini, Cambridge Neurotechnology) and an established protocol with registration were used over five days and sampling periods of 10 s [1]. All participants were instructed to protocol their activities during daytime and sleeping times in a diary, in the case of cognitively impaired patients with explicit support from relatives and/or care staff. Daytime activity was defined as epoch between the first 10-minute consecutive period of activity around the reported get-up time to the first epoch of at least 10 minutes of consecutively recorded immobile data with no more than one epoch of movement within that time following the reported bed time.

2.3. Cognition

Neuropsychological testing was performed by experienced and trained clinical staff. Neuropsychiatric diagnoses were made by a research psychiatrist together with the treating physician. For neuropsychological screening the DemTect battery was used. This is a short battery of paper-pencil tests established for detecting cognitive dysfunction even in predementia stages of Alzheimer's disease. DemTect scores range from 0 to 18, with higher scores representing better cognitive functioning. Mild cognitive impairment was diagnosed according to the criteria of Petersen et al. [20] with a slight cognitive decrease in the DemTect-Score and subjective complaints of memory. An extensive memory test was not done.

2.4. Apathy

The presence of apathy was established on the Apathy Evaluation Scale. A score higher than 18 points is associated with an apathic syndrome. Marin et al. developed the Apathy Evaluation Scale [14], an 18-item scale that can be administered as a self-rated scale, as a caregiver paper and pencil test or as a clinician-administered test. This scale was validated in participants with Alzheimer's disease and other dementias, stroke and major depression. In this study an authorized and validated German version of the Apathy Evaluation Scale (AES, clinician rating) was used [13].

2.5. Other clinical ratings

Trained interviewers administered a detailed questionnaire that included questions about age, education, alcohol intake during previous 30 days, and history of health conditions.

The Beck Depression Inventory was used to assess depressive symptoms. Number of functional limitations was determined by assessing the Barthel-Index. Quality of life was measured using the WHO-QoL (OLD).

2.6. Data analysis and statistics

Commercially available software was used for data transfer and to generate detailed activity profiles. Data were carefully reviewed and checked for missing values and outliers. Diary entries were used to validate automatic sleep scoring. Data analysis was reviewed by a second researcher, who was blind for the clinical diagnosis (for details of pilot testing see [14]. Group differences were analysed by Anova after inspection for normal distribution and with appropriate corrections; correlations were calculated as Spearman's rho using SPSS for Windows.

3. Results

Overall, subjects had a mean ± standard deviation age of 81 ± 7 (Controls: 78, subjects with MCI with/without apathy 79 ± 4/86 ± 4, participants with dementia without apathy 80 ± 2, participants with apathy 82 ± 4) (Table 1).

Activity during the daytime was registered as activity counts per 10 second epochs. MCI and dementia was associated with reduced of daytime activity (DtA), dementia more than MCI (Fig. 1).

In the two groups of participants with MCI and dementia apathy was associated with a reduced daytime activity, independent of the degree of cognitive impairment (no group by apathy interaction ($F(1, 46) = 2{,}6$, $P = 0.11$). AES scores correlate with DtA, Spearman-Rho = −500(**), significance level 0.01 (two-sided) (Fig. 2).

Age correlates with DtA ($\rho = 0.24$, $P < 0.05$), however, results remain the same when age is included as a covariate into Anovas ($F(1,46) = 4.175$, $P < 0.05$). High apathy scores were associated with a negative impact on quality of life (Fig. 3).

Table 1
Demographic and clinical data of participants, $n = 76$ (mean ± SD).

	Controls	MCI-apathy	MCI+ apathy	Dementia-apathy	Dementia+ apathy
Age	78 ± 7	79 ± 4	86 ± 4	80 ± 2	82 ± 4
Number	23	10	11	12	20
Gender m/w	4/19	1/10	0/11	2/12	3/20
Neurological diagnosis	n/a	n/a	n/a	9 DAT, 2 VD, 1 FTD	15 DAT, 3 VD, 2 MXD
DtA	57.46 ± 16.77	57.9 ± 11.13	39.21 ± 15.8	43.65 ± 13.79	38.76 ± 15.1
DemTec	16.15 ± 1.84	9.7 ± 0.67	9.5 ± 0.71	5.5 ± 0.9	6.25 ± 1.62
Barthel-Index	97.17 ± 5.18	96.50 ± 4.12	85.56 ± 12.36	92.5 ± 9.15	86.67 ± 10.04

AESD-C: authorized German translation of the Apathy Evaluation Scale-clinician rated; DAT: dementia of Alzheimer type; FTD: fronto temporal dementia; MXD: mixed dementia; n/a: not applicable or not assessed; SD: standard deviation; VD: vascular dementia.

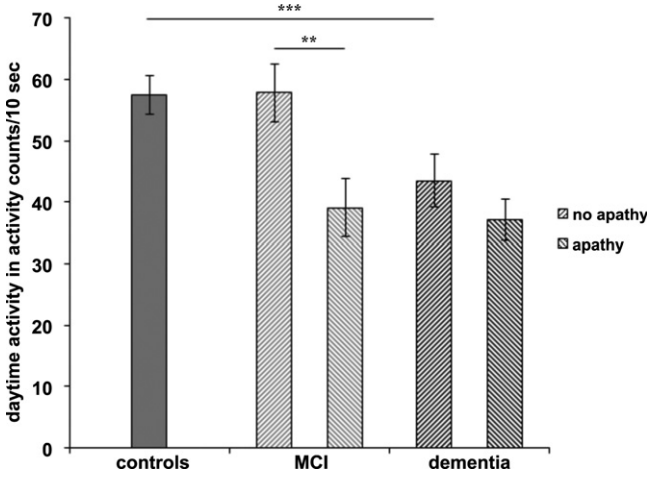

Fig. 1. Mean activity during daytime, registered as activity counts per 10 second epochs in controls, participants with cognitive impairment with or without significant symptoms of apathy (** $P = 0.005$; *** $P < 0.001$).

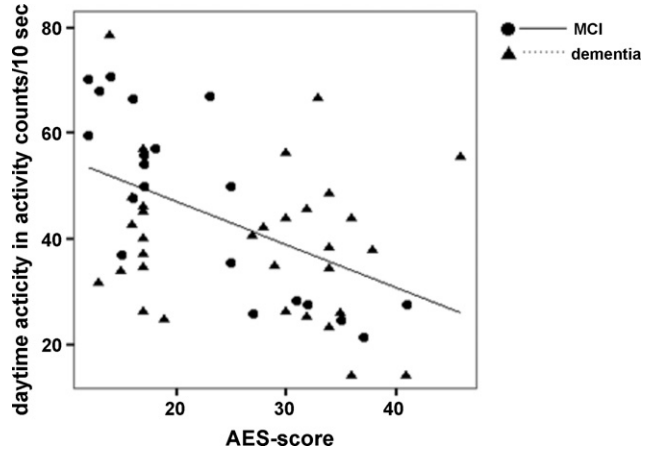

Fig. 2. Scatterplot of correlation between apathy (AES scores) and daytime activity ($r = -50$, $P < 0.01$, two-sided).

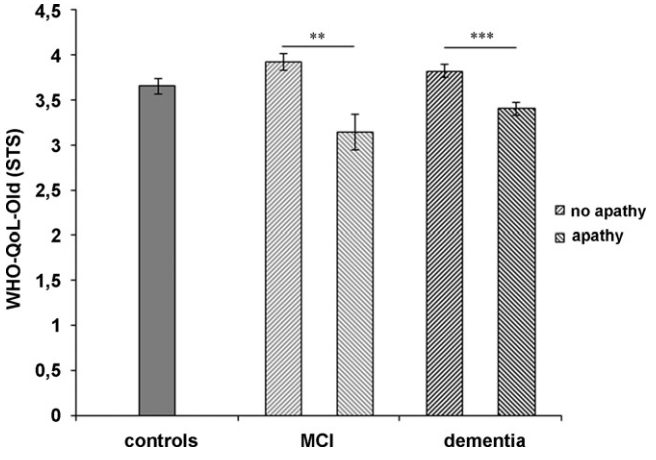

Fig. 3. Participants with cognitive impairment with a relevant apathy syndrome show lower QoL score. (** $P = 0.005$; *** $P < 0.001$).

4. Discussion

This study shows that ambulatory actigraphy can be used for observer-independent quantification of locomotor activity in participants with cognitive impairment and apathy.

Correlations between actigraphy data and apathy ratings show that, regarding the limits of this method, apathy can be detected and quantified by ambulatory actigraphy.

Previous studies have shown that daytime activity is reduced in participants with Alzheimer's disease and frontotemporal dementia [19,24], but this is the first study that shows that apathy has an effect on daytime activity as measured with actigraphy in participants with MCI. Furthermore actigraphic recordings correlate positively with AES total scores, so we can accept an influence of apathy on daytime activity. Reduced daytime activity in the high apathy group was similar to findings in participants with dementia [8], chronic schizophrenia [16] and acquired brain damage [18].

A limitation of this study is the relatively small sample size; however, the aim was to show an association of daytime activity and AES score in participants with dementia and MCI. Data of ambulatory actigraphy are easily confounded by activities of daily living, movement disorders, fatigue [22] and functional status. Participants with movement-disorders and depressive symptoms or severe psychiatric disorders, which at least can be associated with movement disorders, have been excluded, but this study did not control explicitly for fatigue and can, therefore, not distinguish, if high apathy participants have less activity counts because they are more tired or less motivated. In general there is an overlap between the two diagnostic concepts of apathy and depression. To minimize confounders because of this problem, subjects with a depression detected in the BDI were excluded. Correlation results remain the same when age or Barthel index is included as a covariate into Anovas. There is, however, a conceptual overlap between disorders of diminished motivation and fatigue [15].

Similar activity profiles in healthy controls and participants with MCI without a relevant apathy syndrome and correlations between actigraphy data and apathy ratings support the idea underlying this study, i.e. that apathy can be detected and quantified by ambulatory actigraphy. Ambulatory actigraphy could become a promising diagnostic tool in follow-up measurements in clinical trials of pharmacological [3,6,18] and other interventions [1,15,17,25] that aim to improve apathy and related functional deficits in patients with neuropsychiatric disorders.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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