

# The role of impairment of higher mental functions in suicidogenesis in the dementia caused by Alzheimer's disease

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**Background.** Dementia is the age-related disease. At the same time, the elderly age has one of the peaks in the number of suicides. Psychology of patients with dementia is characterized by the feeling of hopelessness, pessimism, awareness of own insolvency, dependence on others, that affects the risk of suicide. It is established that the highest risk of suicide in the early stages of dementia with the progression of cognitive deficit, the risk of suicide decreases.

**Aim.** To study the role of impairment of higher mental functions (perception, reasoning, attention, memory, emotions, will, speech) in the formation of suicidal behaviour in patients with dementia in Alzheimer's disease.

**Materials and methods.** There were examined 75 patients with dementia in Alzheimer's disease, 36 patients with a history of suicidal behavior composed the main group, and 39 patients without the signs of suicidal behavior composed control group. The study was carried out using clinical-anamnestic, psychopathological methods and mathematical statistical methods.

**Results.** The high risk of suicide in dementia caused by Alzheimer's disease is combined with the inhibition of thinking, the delusional ideas of self-blame and self-effacement ( $p \leq 0.05$ ); depressed mood, inner agitation, anxiety, feeling of despair, hopelessness, guilt, melancholia, apathy ( $p \leq 0.05$ ); effector-volitional disorders in the form of hypobulia, hypokinesia, hypomimia, decreased libido ( $p \leq 0.05$ ); speech disturbance in the form of bradylalia  $p \leq 0.05$ ; greater exhaustion and decreased attention ( $p \leq 0.05$ ). On the contrary, the following peculiarities of higher mental functions, namely thought disorder are referred to the anti-risk factors of suicide in dementia caused by Alzheimer's disease: the delusional ideas of relation and damage ( $p \leq 0.05$ ); emotions: the feeling of fear ( $p \leq 0.05$ ); effector-volitional sphere: parabulia and hyperkinesia ( $p \leq 0.05$ ).

**Conclusion.** On the basis of clinical and psychopathological study of patients with dementia in Alzheimer's disease, the specific impairment of higher mental functions and emotional-volitional spheres (reasoning, memory, attention, perception, speech, emotions) are identified associated with high risk of suicide.

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## Background

Suicide is the leading cause of mortality among people of different ages. Older age is associated with the high prevalence of suicides. The factors of suicide in the elderly include the deterioration of physical and mental health, social isolation and the inability to plan and perform complex actions [1,2,3]. According to some researchers about 7% of patients with Alzheimer's disease are admitted to psychiatric clinics after suicide attempts.[2].

Scientists' opinions about the connection between Alzheimer's disease and suicide are different. Thus, the involvement of the neurodegenerative process in suicide was proved in the scientific

works [1,4]: during the post-mortem histochemical, pathomorphologic study of suicides in the age of more than 60 years, the tau protein, Lewy bodies, hippocampal atrophy, amyloid beta were found to be significantly more frequent than in those who deceased due to somatic disease.

On the contrary, the results of another post-mortem examination of the brain of elderly who committed suicides show a lack of dependence between atrophic changes in the brain and the frequency of suicide [3].

Along with cognitive deficit, more than 50% of patients with dementia due to Alzheimer's disease have psychotic (hallucinations and delusions), affective (anxiety, depression, emotional instability) and behavioural disorders (aggression, breakdown, agitation, eating disorders, suicidal behaviour). The presence of comorbid depressive symptoms in patients with dementia profoundly decreases the quality of life and the level of social functioning and increases the risk of suicide compared with the general cohort of the elderly [1,2,6].

According to the literature, the clinical and psychopathological determinants of suicidal behavior in dementia due to Alzheimer's disease include self-awareness of intellectual failure, pessimism, low self-esteem, high degree of dependence from others, initial stage of dementia, attempted suicide in the past. With the development of cognitive deficits, the risk of suicide in patients with dementia decreases [1,2,5,6].

The lack of fundamental research on the suicide risk and anti-risk factors in patients with dementia in Alzheimer's disease substantiates the relevance of our study.

## **Aim**

The aim of the article is to study the role of impairment of higher mental functions and emotional and executive function, including perception, reasoning, attention, memory, language, in suicidogenesis in dementia due to Alzheimer's disease.

## **Methods**

Examination was based on Communal Institutions of Sumy Regional Council «Sumy geriatric boarding house for veterans of war and labor», «Sumy Regional Clinical Hospital for Veterans of the War», «Sumy City Clinical Hospital № 4», «Sumy Regional Clinical TB Dispensary». The following research methods were used: clinical interview (collection of complaints, anamnesis from a patient and his relatives), experimental psychological examination by a psychologist, psychometric: way to determine the severity of suicidal risk (WDSSR) (Havenko V. L. co-authored, 2001), HDRS (Hamilton M., 1967). All patients were divided into 2 groups according to the presence or absence of suicidal risk (SR). To determine the predictors of suicidal behaviour, we investigated the features of patients with high suicide risk according to the WDSSR (>23 points) and the presence of suicidal behaviour in a clinical and anamnestic examination (taking into account the presence of suicidal thoughts, anti-vital expressions, intentions, real suicide attempts). These patients were included in the main group (with high suicide risk), and patients without signs of suicidal behaviour (attempts, suicidal thoughts, statements, intentions) and the results of the SSRS method (<23 points) were included in the comparison group.

There were 75 patients with dementia due to Alzheimer's disease in total. Based on the above features, all patients were divided into the main group (with the SB) the comparison group (without SB). The main group consisted of 36 patients, and in the comparison group 39.

The statistical processing of the results was carried out using the exact Fisher method and Student's criterion. Representation of patients in accordance with ICD-10 is reflected in [Table 1](#).

Indicators		Main group	Comparison group
		% ± SD	
Dementia in Alzheimer's Disease	F00.0*	13,89 ± 3,68	53,85 ± 9,63
	F00.1*	58,33 ± 10,76	35,90 ± 7,56
	F00.2*	27,78 ± 6,74	10,26 ± 2,56
	F00.9	0	0
Expression of dementia	early*	38,89 ± 8,69	10,26 ± 2,56
	moderate	25,00 ± 6,19	30,77 ± 6,74
	advanced*	36,11 ± 8,25	53,85 ± 9,63
Additional symptoms	Without additional symptoms	25,00 ± 6,19	33,33 ± 7,16
	delusional	25,00 ± 6,19	30,77 ± 6,74
	hallucinatory	44,4 ± 8,4	30,8 ± 7,49
	depressive*	38,89 ± 8,69	15,38 ± 3,72
	mixed*	0	20,51 ± 4,81

**Table 1.** Nosocomial distribution of patients with Alzheimer's disease Legend: \* - statistically significant

Thus, patients with a late onset of Alzheimer's disease (65-75 years), a mixed type of dementia, with an early degree of dementia and comorbid depression ( $p \leq 0.05$ ) prevailed in the main group. In the comparison group (without SB) were more patients with early onset Alzheimer's disease, severe dementia and predominance of mixed additional symptoms in the form of insomnia, psychomotor agitation, agitation, and emotional instability ( $p \leq 0.05$ ).

All cognitive disorders in accordance with the clinical classification (Sidorov P. I., Parnyakov A. V., 2000) were divided into two groups: quantitative (pathology of the associative process) and qualitative (pathology of judgments and inferences) impairment. Impairment of tempo, mobility and purposefulness of cognition were examples of the pathology of the associative process, intrusive thoughts, valuable and delusional ideas, as well as the ability to plan and organize activities to the pathology of judgments and inferences.

## Results

The analysis of mental disorders in patients with Alzheimer's disease allowed to establish that there was a marked decreased of the pace of thinking in the form of mental retardation (83.33% in the main group and 58.97% in the comparison group) among the quantitative pathology of mental activity, impairment of mental mobility processes in the form of predominantly circumstantial and viscous thinking (41.67% and 38.89% for the main group and 48.72% and 23.08% for the comparison group), as well as impairment of the purposefulness of the mental processes that consisted of the presence of clanging and paralogical thinking (19.44% and 13.89% - for the main group and 15.38% and 10.26% - group comparisons) (Table 2).

Indicators		Main group	Comparison group
		% ± SD	
I Pathology of the associative process			
Cognitive tempo impairment	accelerated	2,78 ± 0,78	15,38 ± 3,72
	slowed down*	83,33 ± 9,72	58,97 ± 9,94
Cognitive mobility impairment	detailed	19,44 ± 4,99	23,08 ± 5,33
	circumstanced	41,67 ± 9,09	48,72 ± 9,18
	viscous	38,89 ± 8,69	23,08 ± 5,33
Cognitive purposefulness impairment	futile judgement	2,78 ± 0,78	7,69 ± 1,94
	torn	19,44 ± 4,99	15,38 ± 3,72
	paralogical	13,89 ± 3,68	10,26 ± 2,56
	symbolical	5,56 ± 1,54	7,69 ± 1,94

Indicators	Main group	Comparison group
	% ± SD	
II Pathology of judgments and inferences		
Obsessions	5,56 ± 1,54	7,69 ± 1,94
Idée fixe	25,00 ± 6,19	15,38 ± 3,72
Delusions	ideas of damage*	17,95 ± 4,28
	ideas of attitude *	20,51 ± 4,81
	ideas of self-accusation**	5,13 ± 1,31
	self-deprecation ideas*	2,56 ± 0,67
	ideas of sinfulness	7,69 ± 1,94
	ideas of persecution	23,08 ± 5,33
Difficulty in planning and organizing activities*	61,11 ± 10,89	79,49 ± 9,47

**Table 2.** Cognitive disorders in patients with Alzheimer's Disease Legend: \* - statistically significant

Among pathology of judgments and conclusions, there were difficulties in planning and organizing activities (61,11% in the main group and 79,49% in the comparison group), the presence of ultra-high ideas (25,00% in the main group and 15,38% in the comparison group), as well as the presence of delusional ideas (69.44% in the main group and 76.92% in the comparison group). It should be noted that among the delusional ideas in the patients of the main group, the self-deprecation ideas 25,00% (SD=6,19) self-accusation ideas 19,44% (SD=4,99), and in the comparison group, were ideas of persecution 23,08% (SD=5.33), ideas of attitude 20.51% (SD=4.81) and ideas of damage 17.95% (SD=4.28).

There've been established the probable differences between the patients in the main and control groups, which consisted of the mental retardation predominance in patients with high SR in Alzheimer's disease ( $p \leq 0.05$ ,  $DK = -1.14$ ,  $MI = 0.11$ ), at the time when in patients without SR have been noticed greater difficulties in planning and organizing activities ( $p \leq 0.05$ ,  $DK = 1.14$ ,  $MI = 0.10$ ).

Also, there were divergences in the fable of delusional ideas: the ideas of self-accusation and self-deprecation were more active in patients with high SR ( $p \leq 0.05$ ,  $DK = -5.79$ ,  $MI = 0.41$ ) and ( $p \leq 0.005$ ,  $DK = -9.89$ ,  $MI = 1.11$ ) respectively, and the ideas of damage and attitude prevailing in patients without SR ( $p \leq 0.05$ ,  $DK = 8.10$ ,  $MI = 0.61$ ) and ( $p \leq 0.05$ ,  $DC = -5.67$ ,  $MI = 0.42$ ) respectively.

The analysis of emotional disturbances among patients with Alzheimer's disease has shown that in the main group of patients the depressive affect was 77.78% (SD=10.48), the feeling of despair 63.89% (SD=10.97), hopelessness 58.33% (SD=10.76) and helplessness 55.56 (SD=10.58), as well as anxiety 55.56% (SD=10.58), closure 52.78% (SD=10.36), asthenia 50.00% (SD=10.10) and verbal aggression 50.00% (SD=10.10) (Table 3).

Indicators	Main group	Comparison group
	% ± SD	
Internal anxiety*	41,67 ± 9,09	20,51 ± 4,81
Fear*	13,89 ± 3,68	38,46 ± 7,94
Apathy*	44,44 ± 9,46	23,08 ± 5,33
Emotional instability	22,22 ± 5,60	30,77 ± 6,74
Irritability	44,44 ± 9,46	48,72 ± 9,18
Feeling of despair *	63,89 ± 10,97	28,21 ± 6,29
Depression affect*	77,78 ± 10,48	25,64 ± 5,82
Anxiety*	55,56 ± 10,58	30,77 ± 6,74
Verbal aggression	50,00 ± 10,10	48,72 ± 9,18
Physical aggression	41,67 ± 9,09	25,64 ± 5,82

Indicators	Main group	Comparison group
	% ± SD	
Asthenia	50,00 ± 10,10	38,46 ± 7,94
Autism*	52,78 ± 10,36	17,95 ± 4,28
Guilt (shame)*	47,22 ± 9,80	23,08 ± 5,33
Hopelessness*	58,33 ± 10,76	30,77 ± 6,74
Helplessness	55,56 ± 10,58	38,46 ± 7,94
Exhaustion	33,33 ± 7,78	33,33 ± 7,16
Euphoria	0,00	7,69 ± 1,94

**Table 3.** Emotional violation in patients with Alzheimer's disease Legend: \* - statistically significant

In the control group, among the affective manifestations, irritability 48,72% (SD=9,18), and verbal aggression 48,72% (SD=9,18) have prevailed, and also feelings of fear 38,46% (SD=7,94), asthenia 38,46% (SD=7,94) and the helplessness 38,46% (SD=7,94).

A comparative analysis between the main and comparison groups in Alzheimer's patients showed that the feeling of fear was prevalent in patients in the comparison group ( $p < 0.01$ ,  $DK = -4.42$ ,  $MI = 0.54$ ), while for patients with high SR was predominance of depressed mood ( $p \leq 0.0001$ ,  $DK = -4.82$ ,  $MI = 1.26$ ), internal anxiety ( $p \leq 0.025$ ,  $DK = -3.08$ ,  $MI = 0,33$ ), sense of despair and hopelessness ( $p \leq 0.001$ ,  $DK = -3.55$ ,  $MI = 0.63$ ) and ( $p \leq 0.01$ ,  $DK = -2.78$ ,  $MI = 0.38$ ) respectively), apathy ( $p \leq 0,05$ ,  $DK = -2,85$ ,  $MI = 0,30$ ), anxiety ( $p \leq 0,01$ ,  $DK = -2,57$ ,  $MI = 0,32$ ), closure ( $p \leq 0,001$ ,  $DK = -4.68$ ,  $MI = 0.82$ ) and feeling of guilt ( $p \leq 0.01$ ,  $DK = -3.11$ ,  $MI = 0.38$ ).

Clinical psychopathological analysis of volitional impairment in patients with Alzheimer's disease made it possible to determine that 77.78% of patients in the main group experienced inhibition of intensity and number of random motions; in 80.56%, there was a decrease in libido and 41.67% of patients with high SR showed an inhibition of food craving, which was manifested as signs of anorexia (Table 4).

Indicators	Main group	Comparison group
	% ± SD	
I. Impairment of the motivational component of a volitional act		
hypobulia*	77,78 ± 10,48	53,85 ± 9,63
anorexia	41,67 ± 9,09	28,21 ± 6,29
decreased libido*	80,56 ± 10,15	53,85 ± 9,63
hyperbulia	11,11 ± 2,99	15,38 ± 3,72
bulimia	11,11 ± 2,99	15,38 ± 3,72
increase libido	0	0
parabulia*	11,11 ± 2,99	30,77 ± 6,74
II. Impairment of the implementation of volitional efforts		
hypokinesis*	41,67 ± 9,09	23,08 ± 5,33
hypomimia*	52,78 ± 10,36	28,21 ± 6,29
hyperkinesis *	5,56 ± 1,54	25,64 ± 5,82
parakinesis	2,78 ± 0,78	7,69 ± 1,94
negativism	25,00 ± 6,19	20,51 ± 4,81
echopraxia	8,33 ± 2,28	12,82 ± 3,15
echolalia	22,22 ± 5,60	17,95 ± 4,28

**Table 4.** Impairment of the volition and motivation in patients with Alzheimer's disease Legend: \* - statistically significant

Impairment of the motivational component of the volitional act in the patients from the comparison group was also represented by hypobulia 53.85% (SD=9.63), decreased libido 53.85% (SD=9.63) and appetite 28.21% (SD=6.29), as well as distortion of appetences, incentives and motives of

activity 30,77% (SD=6,74).

Volition impairment in patients with Alzheimer's disease were presented in the main group predominantly with hypomimia (52.78 ± 10.36)% and hypokinesia 41.67% (SD=9.09).

A comparative analysis of the main and the comparison groups allowed to establish that the inhibition of the volitional process ( $p \leq 0.01$ , DK = -1.60, MI = 0.19), decrease in libido ( $p \leq 0.01$ , DK = -1.75, MI = 0.23), inhibition of the rate of arbitrary movements ( $p \leq 0.05$ , DK = -2.57, MI = 0.24), decrease in the intensity and expressiveness of arbitrary mimic reactions ( $p \leq 0.01$ , DK = -2,72, MI = 0.33) distinguished patients with high SR from the comparison group, which had more expressive psychomotor excitation ( $p \leq 0.01$ , DK = 6.64, MI = 0.67) and distortion of motor activity ( $p \leq 0,025$ , DK = 4,42, MI = 0,43).

Clinical and psychopathological analysis of speech disorders in patients with Alzheimer's disease allowed us to determine that the main impairment of speech was its stereotyping (88.89% in the main group and 97.44% in the comparison group) (Table 5). The patients in the main group differed from the comparison group with the presence of a slowdown in the pace of speech (47.22 ± 9.80)%, with the differences being statistically significant at  $p \leq 0.01$ , DK = -3.11, MI = 0.38.

Indicators	Main group	Comparison group
	% ± SD	
I. Impairment of verbal communication		
bradylalia*	47,22 ± 9,80	23,08 ± 5,33
stereotyping	88,89 ± 8,47	97,44 ± 4,11
sensory aphasia	33,33 ± 7,78	17,95 ± 4,28
acoustic-mnestic aphasia	50,00 ± 10,10	58,97 ± 9,94
optical-amnestic aphasia	41,67 ± 9,09	43,59 ± 8,62
motor aphasia	25,00 ± 6,19	28,21 ± 6,29
semantic aphasia	36,11 ± 8,25	46,15 ± 8,91
II. Impairment of writing		
dyslexia	8,33 ± 2,28	10,26 ± 2,56
dysgraphia	27,78 ± 6,74	23,08 ± 5,33

**Table 5.** Disorders of speech function in patients with Alzheimer's Disease Legend: \* - statistically significant ( $p \leq 0.05$ )

It should be noted that impairment of verbal speech were manifested in the presence of various aphasia, among which the most were expressed acoustic-mnestic (50.00% for the main group and 58.97% for the comparison group), optical-amnestic (41.67% for the main group and 43.59% for the comparison group) and semantic (36.11% for the main group and 23.08% for the comparable group) aphasia. Impairment of writing were mainly represented by the dysgraphia (27.78% for the main group and 23.08% for the comparison group).

Clinical and psychopathological analysis of attention deficit among patients with Alzheimer's disease made it possible to determine that hypoprosia was the leading cause of attention deficit in this pathology (88.89% in the main group and 89.74% in the comparison group) (Table 6). Impairment of attention in patients with Alzheimer's disease consisted not only in reducing the function of attention, but also in a sharp decrease of it's volume (100% in the main group and 87.18% in the comparison group) and exhaustion (80.56% in the main group and 51.28% - in the comparison group).

Indicators	Main group	Comparison group
	% ± SD	
aprosia	2,78 ± 0,78	0
hypoprosia	88,89 ± 8,47	89,74 ± 7,56

Indicators	Main group	Comparison group
	% ± SD	
paraprosexia	8,33 ± 2,28	10,26 ± 2,56
absentmindedness	33,33 ± 7,78	46,15 ± 8,91
exhaustion*	80,56 ± 10,15	51,28 ± 9,42
narrowing the amount of attention*	100	87,18 ± 8,21

**Table 6.** Impairments of attention in patients with Alzheimer's disease Legend: \* - statistically significant

A comparative analysis between the main and the control groups allowed us to determine that in the group of patients with high SR, impairment of attention in the form of exhaustion ( $p \leq 0.005$ ,  $DK = -1,96$ ,  $MI = 0,29$ ) and narrowing the amount of attention ( $p \leq 0,05$ ,  $DK = -3.60$ ,  $MI = 0.04$ ) were more pronounced than in the comparison group.

In patients with Alzheimer's disease, progressive amnesia (77.78% of the patients in the main group and 69.23% of the patients in the comparison group) and fixation amnesia (58.33% in the main group and 58.97% in the control group) were expressed in terms of quantitative impairment of the mnemonic function (Table 7).

Indicators		Main group	Comparison group
		% ± SD	
quantitative violations	fixation amnesia	58,33 ± 10,76	58,97 ± 9,94
	progressive amnesia	77,78 ± 10,48	69,23 ± 10,11
qualitative violations	pseudoreminiscences	22,22 ± 5,60	23,08 ± 5,33
	confabulations	13,89 ± 3,68	20,51 ± 4,81

**Table 7.** Violation of mnemonic functions in patients with Alzheimer's Disease

Among the qualitative impairment, pseudoreminiscences were noted (22.22% in the main group and 23.08% in the comparison group) and confabulations (13.89% in the main group and 20.51% in the control group). Comparison of the main and the control groups did not show the significant differences in the specific features of impairment of the mnemonic function.

Clinical and psychopathological analysis of impairment of mnemonic function in patients with mixed type dementia allowed to determine that among quantitative disorders in most patients were detected such violations of mnemonic functions as losing ability to remember and decreasing of memory by Ribot's law (76,67% in the main group and 86.67% in the control group) (Table 8). Also in 63.33% of patients of the main group and in 83.33% of patients in the comparison group was observed fixation amnesia that manifested in impairment of the ability to remember.

Qualitative impairment of mnemonic functions was demonstrated by the presence of pseudoreminiscences (30.00% in the main group and 40.00% in the comparison group) and confabulations (36.67% in the main group and 40.00% in the comparison group) what was manifesting in false memories.

Clinical and psychopathological analysis of perceptual impairment in patients with Alzheimer's disease demonstrated that the patients in the main group showed sensory synthesis disturbances, which was manifested predominantly in the presence of derealisations in patients 50.00% ( $SD=10.10$ ), and were widely reported as agnosias ( $44.44 \pm 9.46$ )% and visual hallucinations 30.56% ( $SD=7.28$ ) (Table 8). Impairment in the perception process in patients of the comparison group were manifested mainly in the presence of agnosias 51.28% ( $SD=9.42$ ). There were no significant differences between the main and the comparison group.

Indicators		Main group	Comparison group
		% ± SD	
Psychosensory disorders	Derealisation	50,00 ± 10,10	33,33 ± 7,16
	Depersonalisation	11,11 ± 2,99	15,38 ± 3,72
Illusions		22,22 ± 5,60	23,08 ± 5,33
Agnosias		44,44 ± 9,46	51,28 ± 9,42
Hallucinations	Auditory	16,67 ± 4,35	20,51 ± 4,81
	Visual	30,56 ± 7,28	25,64 ± 5,82

**Table 8.** Perceptual impairment in patients with Alzheimer's Disease

## Conclusions

Based on a features comparison of higher mental functions in patients with dementia of the Alzheimer's type with signs of a SB and without a SB there have been identified impairment that increase the risk of suicide in this pathology.

Thus, there is a high risk of suicide in dementia due to Alzheimer's disease, with patients who have cognitive disorders in the form of inhibition, delusional ideas of self-accusation and self-deprecation ( $p \leq 0.05$ ); impairment of emotions in the form of depressed mood, internal anxiety, anxiety, feeling of despair, hopelessness, guilt, autism, apathy ( $p \leq 0,05$ ); effector - volitional disorders in the form of hypobulia, hypokinesia, hypomimia, decreased libido ( $p \leq 0.05$ ); impairment of the language in the form of bradylalia ( $p \leq 0,05$ ); greater exhaustion and narrowing of the amount of attention ( $p \leq 0.05$ ).

Low risk of suicide in dementia due to Alzheimer's disease had patients with mental impairment in the form of delusional ideas of attitude and damage ( $p \leq 0.05$ ); emotional violations in the form of a sense of fear ( $p \leq 0.05$ ); effector-volitional disorders in the form of parabulia and hyperkinesia ( $p \leq 0.05$ ).

## Additional information

### Competing interests

The author declares that no competing interests exist.

## References

1. Serafini G, Calcagno P, Lester D, Girardi P, Amore M, Pompili M. Suicide Risk in Alzheimer's Disease: A Systematic Review. *Curr Alzheimer Res.* 2016; 13(10):1083-99. [PubMed](#)
2. Barak Y, Aizenberg D. Suicide amongst Alzheimer's disease patients: a 10-year survey. *Dement Geriatr Cogn Disord.* 2002; 14(2):101-113. [DOI](#) | [PubMed](#)
3. Matschke J, Sehner S, Gallinat J, Siegers J, Murrioni M, Püschel K, Glatzel M. No difference in the prevalence of Alzheimer-type neurodegenerative changes in the brains of suicides when compared with controls: an explorative neuropathologic study. *Eur Arch Psychiatry Clin Neurosci.* 2018; 268(5):509-517. [DOI](#) | [PubMed](#)
4. Rubio A, Vestner AL, Stewart JM, Forbes NT, Conwell Y, Cox C. Suicide and Alzheimer's pathology in the elderly: a case-control study. *Biol Psychiatry.* 2001; 49(2):137-145. [PubMed](#)
5. Chappell P, Dubrava S, Stewart M, Hartley DM, Alphs L, Brashear HR, Conwell Y, Miller D, Schindler RJ, Siemers ER, Yaffe K. Suicidal ideation and behavior assessment in dementia studies: An Internet survey. *Alzheimers Dement* 2016;. 23; 2(1):60-68. [DOI](#)
6. Maruta N. , Mudrenko I. *Predictors of a suicidal behavior in patients with dementia 25th*



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