

# Prevalence of behavioral risk factors and their association with dementia in the urban population of North India

## Abstract

**Background:** Dementia has become a public health problem due to its association with behavioural risk factors; smoking, alcoholism, sedentary behaviour, western type diet, obesity, diabetes, and hypercholesterolemia. Most of these behavioural risk factors appear to be associated with dementia as well as with risk of cardiovascular diseases (CVDs) and diabetes. This study aims to find out the prevalence of behavioural risk factors and their association with cognitive deficit and dementia.

**Study design and setting:** Cross-sectional survey in a hospital.

**Subjects and methods:** After written informed consent and approval from hospital ethic committee, all subjects (n=2002) above 25 years of age (1016 males and 986 females) were randomly selected and recruited from urban population of Moradabad, North India. Clinical data and risk factors were recorded with the help of case record form and validated questionnaires. Assessment of cognitive decline and dementia was made by a new memory function rating scale and behavioural risk factors by validated questionnaires. The association of behavioral risk factors with dementia was calculated by multivariate logistic regression analysis after adjustment of age and sex, obesity, diabetes and CVDs.

**Results:** Low cognitive activity, low education, sedentary behavior, sleep duration, tobacco intake, alcoholism and western diet, were highly prevalent independent risk factors of dementia. Low education was not associated with risk. Logistic regression analysis revealed that regardless of age and body mass index, sedentary behavior, odds ratio and confidence intervals: (men 0.74 (0.69 - 0.79), women, 0.71 (0.63 - 0.74) and tobacco intake (men 0.88 (0.79 - 0.94), women 0.90 (0.84 - 0.97) and sleep disruption (men 0.80 (0.71 - 0.89), women 0.85 (0.79 - 0.91) were strongly ( $p < 0.001$ ) and significantly ( $p < 0.001$ ) associated with dementia in both sexes, respectively. Alcoholism (men 0.71 (0.65 - 0.78) was also strongly and significantly ( $P < 0.001$ ) associated with dementia in men but not in women. Low cognitive activity, (men 0.83 (0.75 - 0.92), (women 0.89 (0.84 - 0.99), and western diet (men 0.88 (0.80-0.95), (women 0.89 (0.81 - 0.99) were weakly but significantly ( $p = 0.05$ ) associated with dementia in both sexes. Meditation and prayer was inversely associated with dementia among (men 0.92 (0.85 - 0.99) and (women 0.90 (0.85 - 0.97).

**Conclusions:** It is possible that increased physical activity, no tobacco and alcoholism, optimal sleep, intake of healthy foods, meditation and prayer, high cognitive activity, and good sleep for 6-8 hours, can protect against dementia.

**Keywords:** western diet, sedentary behavior, mastication, cardiovascular diseases

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## Introduction

Western type of diet is the leading cause of death and is the first or second biggest contributor of non-communicable diseases (NCDs) including dementia.<sup>1-3</sup> According to WHO estimates, the strength of people living with dementia could be as high as 50 million.<sup>2</sup> It seems that by 2030, it may be projected to increase to 75 million. The frequency of dementia may be estimated to be three fold more by 2050. Interestingly, the global count of dementia in 1990 was 20.2 million, which became 43.8 million in 2016. This increase of 117% contrasted with a minor increase in age-standardised prevalence of 1.7%, from 701 cases per 100 000 population in 1990 to 712 cases per 100 000 population in 2016.<sup>4</sup> It seems that globally, dementia was the fifth leading cause of death, accounting for 2.4 million deaths.<sup>4</sup> The strength of people with dementia will increase in the Asia-Pacific region, from 23 million in 2015 to almost 71 million by 2050. It is possible that half of these deaths could be due to the modifiable risk factors of obesity, diabetes, smoking, and a greater consumption of sugar-sweetened foods.<sup>4</sup>

In a recent study, dietary concern was strongly associated with mild cognitive impairment, among South African older adults, indicating that lack of functional foods intake may be inversely associated with memory dysfunction.<sup>5</sup> Previous studies also indicated that modern ready prepared foods, are a risk factor of dementia, whereas fruits, vegetable and whole grain rich diets may be protective factor against dementia.<sup>6-8</sup> Apart from diet, tobacco, sedentary behaviour, alcoholism, night time eating, lack of protective behaviours such as mastication are also predisposing factors of dementia.<sup>9,10</sup> It is possible that diet and lifestyle transition with western style foods, rich in sugary refined foods, preserved meats, along with white rice, potato and animal foods, common in Asia in conjunction with other unhealthy behaviours may indicate the rising trend in the risk of dementia in Japan and other Asian countries.<sup>7-10</sup> In earlier publications based on the subjects of this study, we reported prevalence of hypertension,<sup>11</sup> nutritional factors and questionnaire for assessment and social classes of dementia.<sup>12,13</sup> This study, aims to examine the prevalence of behavioural risk factors and their association with risk of dementia in an urban population of north India.

## Subjects and methods

This cross-sectional survey included randomly selected 20 streets from the urban area of the city of Moradabad.<sup>11</sup> All the subjects were randomly selected, based on voter's list, with an aim of choosing, 40-100 adults, aged 25 years and above, from each block. We invited 2422 subjects aged 25 years and above, of which 220 (9.08%) did not volunteer to participate and rest 2002 (1016 men and 986 women) agreed to be part of this study. Further details of subjects and methods are given in the earlier publications.<sup>11-13</sup> We performed detailed interviews, with the help of pretested and validated questionnaires, for assessment of behavioral risk factors and protective factors, prepared according to the guidelines of WHO and Indian Council of Medical Research. Assessment of dietary intakes, was made by 7-day food intake record in the diaries and recorded by questionnaires as reported earlier.<sup>11-13</sup> All the subjects were evaluated by a dietitian and physician administered questionnaire, a physical examination and sphygmomanometer and blood tests.

### Criteria for Diagnosis of Behavioral Risk Factors and Dementia

The criteria for the diagnosis of some of the behavioral risk factors; tobacco intake, western type diet, sedentary behavior and alcoholism as well as memory dysfunction or dementia were based on previous studies, that have already been reported.<sup>12</sup> In brief, dementia was diagnosed based on Singh's memory function rating instrument.<sup>12</sup> Mild memory dysfunction (MMD) was identified if there was possible impairment of memory (score 21 - 40). Impairment of memory was considered if the score was 41-60. The presence of dementia was identified at score 61-80 on the basis of the instrument.<sup>12</sup>

The diagnosis of sedentary behavior was made on the basis of occupational and household activities and spare time activities. Sedentary behavior was considered if there was no spare time exercise and if subject had less than 14.5 km of walking per week and/ or climbing fewer than 20 flights of stairs a week, during household activities in absence of moderately spare time physical activity.<sup>11-13</sup> Tobacco is consumed in India as; cigarettes, beedis, Indian pipes, raw tobacco and people use tobacco in more than one form. Thus users of any form of tobacco were called as smokers as was done in earlier publications.<sup>11</sup> Alcohol ingestion of greater than once weekly was accepted as alcohol intake and people taking in excess of 10 drinks per week was called alcoholism.

Food and nutrient intakes were calculated with the help of nutrient composition of Indian foods tables (18). Food models were used to find out the components of diet. Eating >300g of western type of foods such as bread, biscuits, pastries, cakes and other junk foods and syrups was considered as western diet intake. Eating healthy foods such as fruits, vegetable, legumes and nuts (>400g/day) was considered to have consumption of Indo-Mediterranean diet. Low cognitive activity was diagnosed based on questionnaires related with mental work such as reading newspaper or any other written material. Sleep disruption was considered in presence of sleep in the night of < 6 hours duration and/or excess of awakening >3 times, during sleep in the night or night shift work. Low education was considered in presence of total education of <5 years in school.

Mood and anxiety disorder was considered in presence of anxiety during talking, excess of thinking, due to occupational stress or financial stress, causing difficulty in sleep, for minimum 4 weeks or more or having records of having depression. Practicing yoga and or meditation or active prayer, for >30 min at least 5 days in a week was diagnosed as meditation and yoga practice. Eating energy restricted

diet or fasting (< 800 calorie /day at least once weekly was considered practice of energy restriction and fasting. Optimal mastication of foods was considered if the number of mastication was > 20/ bite.

### Statistical analysis

The continuous variables are given as mean and standard deviation and prevalence rates in percent. Statistical value of association of various risk factors was found out by multivariate logistic regression analysis. The odds ratios and 95% confidence intervals were obtained to find out the level of significance using multivariate model. This was done after adjustment of age and sex as well as well as other biological and metabolic risk factors using overall prevalence of cognitive deficit, as the dependent variable. Only P values < 0.05 and two tailed t test were considered significant.

## Results

The results showed that the prevalence of dementia was significantly greater among subjects above 55 years of age in both sexes and trend was significant as reported earlier.<sup>12</sup> The prevalence of protective factors and risk factors of dementia are given in Table 1. The prevalence of tobacco and alcoholism were significantly more common among men whereas meditation and prayer were significantly more common among women. The prevalence of age >60 years, significantly more common among men compared to women. The prevalence of mood and anxiety disorders, western type diet intake, sedentary behavior, low cognitive activity, low education and sleep disruption were common behavioral risk factors found in both sexes. The prevalence of protective factors against dementia such as intake of Indo-Mediterranean style diets, energy restriction and fasting and mastication of food during eating were quiet common in both sexes Table 1.

**Table 1** Prevalence of risk factors and protective factors of dementia among men and women

Risk factors and protective factors of dementia	Men (n=1016)	Women (n=986)	Total (n=2002)
<b>Behavioral factors</b>			
Tobacco intake	202(19.8)**	18(1.8)	220(10.9)
Alcoholism (>10 drinks/ week)	31(2.9)**	-	31(1.5)
Western type diet	518(51.0)	492(50.0)	1018(50.8)
Sedentary behavior	768(75.6)	789(80.0)	1557(77.8)
Low cognitive activity	105(10.3)	118(12.0)	223(11.7)
Low education (<5 years)	85(8.4)	97(9.8)	182(9.1)
Sleep disruption (<6 hours/day)	143(14.07)	131(13.28)	274(13.68)
Mood and anxiety disorders	225(22.1)_	215(21.8)	440(22.0)
<b>Protective factors</b>			
Meditation and prayer >30 min	251(24.70)	518(52.53)*	769(38.41)
Indo-Mediterranean foods (>400g/day)	98(9.64)	97(9.84)	195(9.74)
Energy restriction and fasting, once daily/week or more	127(12.50)	113(11.46)	240(11.98)
Mastication of foods. (>20 mastication/bite)	231(22.73)	197(19.98)	428(21.38)

\*=P<0.05, \*\*=P<0.01, by Chi square test, Values are number (%).

The frequency of behavioral risk factors and biological risk factors among patients with dementia and those without dementia are given in Table 2. The frequency of tobacco intake, alcoholism, western type diet intake and sedentary behavior, low cognitive activity, low education, optimal sleep duration and mood and anxiety disorders were significantly higher among participants having memory dysfunction and dementia in comparison to subjects having no dementia Table 2.

**Table 2** Frequency of behavioral and biological risk factors of dementia among patients of dementia compared to rest of the subjects in both sexes combined

Risk factors	Dementia (n=137) No (%)	No dementia (n=1865) No (%)
<b>Behavioral risk factors</b>		
Tobacco(>once/week)	39(28.4)**	181(9.1)
Alcoholism(>10drinks/wk)	8(5.8)*	23(1.2)
Western type diet {>300g/day}	93(67.8)*	925(49.6)
Sedentary behavior (AHA)	124(90.5)*	1433(76.8)
Low cognitive activity (< 1hour /day)	34(24.8)**	199(10.7)
Low education (< 5 classes)	26(18.9)*	156(8.4)
Sleep duration (< 6 hours)		
Mood and anxiety disorders	43(31.4)*	397(21.3)

\*=P <0.0, \*\*= P<001, P values were calculated by Chi square test. Tobacco and alcohol are not common in women.

Multivariate logistic regression analysis showed that regardless of age and body mass index, sedentary behavior, tobacco intake and sleep duration were strongly associated with dementia in both sexes. Alcoholism was also strongly associated with dementia in men but not in women. Low cognitive activity and western diet were weakly associated with dementia in both sexes. Meditation and prayer was inversely associated with dementia among men and women. Low education was not associated with dementia Table 3.

**Table 3** Multivariate logistic regression analysis for association of risk factors with risk of dementia after adjustment of age and body mass index, among men and women

<b>Dementia</b>		
Risk factors	Men (n=1016) Odds ratio (95% confidence interval)	Women (n=986) Odds ratio, (95% confidence interval)
Alcoholism	0.71(0.65-0.78)**	0.78 (0.65- 0.96)
Sleeping disruption	0.80(0.71-0.89)**	0.85 (0.79-0.91)**
Meditation and prayer	0.92(0.85- 0.99)*	0.90 (0.85-0.97)*
Sedentary behavior	0.74 (0.69-0.79) **	0.71 (0.63-0.74)**
Tobacco intake	0.88 (0.79- 0.94)**	0.90(0.84-0.97)**
Low education	0.87(0.71-1.100)	1.11(1.00-1.22)
Western type diet.	0.88(0.80-0.95)*	0.89(0.81-0.99)*
Low cognitive activity	0.83-(0.75-0.92)*	0.89(0.84-0.99)*

Dementia= All the subjects with manifestation of memory dysfunction were included under dementia. \*= P < 0.05, \*\*= P, 0.001, P value was obtained by regression analysis.

## Discussion

The overall prevalence of dementia was 6.84% (n=137) and risk of dementia showed significant increase with increase in age after 55 years as reported earlier.<sup>12</sup> This study shows that regardless of age and body mass index, sedentary behavior and cardio-metabolic risk factors, odds ratio and confidence intervals: (men 0.74 (0.69 - 0.79), women, 0.71 (0.63 - 0.74) and tobacco intake (men 0.88 (0.79 - 0.94), women 0.90 (0.84 - 0.97) and sleep duration (men 0.80 (0.71 - 0.89), women 0.85 (0.79 - 0.91) were strongly and significantly (p<0.001)

associated with dementia in both sexes, respectively. Alcoholism (men 0.71 (0.65 - 0.78) was also strongly associated with dementia in men but not in women. Low cognitive activity, (men 0.83 (0.75 - 0.92), (women 0.89 (0.84 - 0.99) and western diet (men 0.88 (0.80 - 0.95), (women 0.89 (0.81 - 0.99) were weakly but significantly (p<0.05) associated with dementia in both sexes. Meditation and prayer was also weakly but inversely associated with dementia among (men 0.92 (0.85 - 0.99) and (women 0.90 (0.85 - 0.97). Low education was not associated with dementia which may on account of confounding due to higher occupational physical activity among these subjects. Alcoholism is uncommon among Indian women.

In addition, to biological risk factors, there is evidence from several epidemiological studies that tobacco intake, alcoholism, sleep disorders, low education, low cognitive activity, and western diet are associated with dementia.<sup>1-3,9,10</sup> The Hisayama study, among 1006 subjects, aged 60-79, showed that after 15-year follow-up, 271 patients had dementia. Interestingly, out of the 271 patients, 144 had AD, and 88 of them vascular dementia.<sup>6</sup> A higher adherence to a dietary pattern characterized by a high intake of soybeans and soybean products, vegetables, algae, and milk and dairy products and a low intake of white rice was associated with reduced risk of dementia.<sup>6</sup> In a cohort of older adults (n = 82; aged  $\square$ 68.8 y; 50% fF, 50% minority), the findings showed that compared with the group on low Mediterranean diet score, the group with greater score of Mediterranean style diet, was having better performance in learning and memory function and larger dentate gyri in the brain, examined via neuroimaging.<sup>7</sup> A prospective cohort study among 14,402 elderly ( $\geq$ 65 years), the incidence of dementia was 9.0% with 71,043 person-years of follow-up.<sup>8</sup> The score for the pattern of Japanese diet with healthy eating, was related with a significantly (P<0.016) lower risk of incident dementia.<sup>8</sup>

In an Indian survey among 560 participants, 140 (25%) patients were identified with impairment of cognition and the risk was higher in females (29.8% vs 19.1%) compared to males, respectively.<sup>14</sup> This is in contrast with our findings (male 8.26 % vs female 5.27%, n=84 vs 53) which may be due to greater alcoholism and tobacco, among men. In a cohort, comprising of 1066 subjects, 104 had dementia (98 with AD) during 8.1 years of follow-up.<sup>15</sup> In the elderly subjects, aged  $\geq$ 65 years, the incidence rate was 21.61 per 100,000. These rates of AD, appear to be much greater than that reported from rural north India, comparable with those reported from China, and marginally lower than those reported from the western world.<sup>15</sup> In our study, which is from north India, the prevalence of AD (0.15%, b=3) was quite low which may be due to optimal intake of traditional Indian foods and lower life expectancy.<sup>12</sup> It is clear that a greater adherence to Mediterranean type of diet or Japanese diet, is associated with higher brain structural integrity and global cognitive performance as well as decreased risk of dementia including vascular dementia.<sup>16</sup> The prevalence of dementia, in a previous study, among 595 elderly subjects > 50 years, was 18.6% (n=111) in urban subjects.<sup>17</sup> In view of the ageing of population, the prevalence of people living with dementia would grow, especially in low and middle-income countries.<sup>1-4</sup>

In 2016, the global number of individuals who lived with dementia was 43.8 million (95% uncertainty interval [UI] 37.8 – 51.0), increased from 20.2 million (17.4 – 23.5) in 1990.<sup>4</sup> This increase of 117%, appears to be in contrast with a marginal increase in age-standardized prevalence of 1.7%, from 701 cases, per 100 000 population in 1990 to 712 cases, per 100,000 population in 2016. More women than men had dementia in 2016 (27.0 million vs 16.8 million, 14.4 – 19.6), and dementia was the fifth leading cause of death globally, accounting for 2.4 million deaths. Overall, 28.8 million DALYs were attributed to

dementia; 6.4 million of these could be attributed to the modifiable GBD risk factors; obesity, glycototoxicity, tobacco, and a high intake of western type diet. It seems that, the only viable option as of now is primary prevention of dementia by addressing primary risk factors and promotion of protective factors.<sup>18</sup> A cross-sectional, community-based data on individuals aged  $\geq 50$  years ( $n=3,572$ ) from the World Health Organization's Study on Global AGEing and Adult Health (SAGE) was conducted in South Africa (2007 - 2008).<sup>5</sup> The prevalence of major cognitive impairment (MCI) was 8.5%, while 11.0% and 20.8% experienced moderate and severe food insecurity (increased intake of western foods), respectively. After adjustment for potential confounders, moderate and severe food insecurity were associated with 2.82 (95% CI = 1.65 - 4.84) and 2.51 (95% CI = 1.63 - 3.87) times higher odds for MCI compared with no food insecurity, respectively. The OR for those aged  $\geq 65$  years with severe food insecurity was particularly high (OR = 3.87; 95% CI = 2.20 - 6.81). Food insecurity was strongly associated with MCI among South African older adults which are similar with our findings.

There is evidence that apart from healthful diet, screening and management of dementia should include the effective handling of elderly cohort, emphasizing on lifestyle modification.<sup>18</sup> In a meta-analysis, including 21 studies, the results revealed that by meeting the WHO recommendations for moderate exercise, regular physical activity was inversely associated with a lower risk of Alzheimer's disease.<sup>19</sup> A positive effect of exercise on cognitive function, physical performance, and functional independence was also observed. A recent meta-analysis involving 23 studies of moderate quality revealed that the largest effects of physical activity were seen in terms of improvement in memory function.<sup>20</sup> It seems that spare time physical activity may be an effective method of changing sedentary behavior to treat symptoms of Alzheimer's disease, which may show a low incidence of related adverse events. Apart from physical activity,<sup>20</sup> cognitive work<sup>21</sup> in subjects with sedentary behavior<sup>1,2</sup> may be a confounder.

Epidemiological study involving 6,505 subjects, median age 61 years, (55.2% women), sitting time among men was associated with better performance in memory, language, and executive function tests.<sup>21</sup> Screen time on the weekend, and week time showed a favorable association with beneficial effects on cognitive performance. Interestingly, for women, sitting time and occupational screen time were positively associated with performance on memory tests. It is possible that sedentary behavior favors cognitive function, without evident dementia due to a high level of education. The type of sedentary behavior for example mentally active; teaching and reading may be of particular interest for cognitive performance with lower risk of dementia.<sup>21</sup> In addition, yoga<sup>22</sup> novel ethnic risk factors in Asians,<sup>23</sup> socioeconomic factors,<sup>17,24</sup> mental stress and meditation<sup>25</sup> may also influence the occurrence of dementia.

We found that sleep disruption was associated with increased risk of dementia (Table 3, 4). There is evidence that in non-demented elderly subjects, sleep disruption can predispose core biomarkers of Alzheimer's disease. It seems that loss of sleep, sleep disorders such as poor quality sleep, difficulty in falling asleep, excess of daytime sleepiness and sleep disordered breathing may increase cerebral A $\beta$  deposition causing decline in memory function.<sup>26</sup> In a meta-analysis involving 51 cohorts, 15 sleep problems were observed.<sup>26</sup> The parameters of sleep, such as insomnia, fragmentation, daytime dysfunction, prolonged latency, rapid eye movement sleep behaviour disorder and excessive time in bed showed significant increase in risk of all-cause cognitive disorders. Interestingly, a U-shaped relationship

was observed for the associations with sleep duration and dementia. It is possible that management of sleep may be a promising target for prevention of dementia. Caloric restriction,<sup>27</sup> hunger,<sup>28</sup> intermittent fasting,<sup>29</sup> anxiety and depression,<sup>30,31</sup> tobacco intake<sup>32</sup> and alcoholism<sup>33</sup> as well as chrono-physiological and psychocological factors<sup>34</sup> have been reported to influence dementia.

We also observed that tobacco and alcohol consumption are risk factor of dementia (Table 3, 4). It seems that tobacco consumption and alcoholism are known but controversial risk factors of dementia.<sup>1-4,32,33</sup> In a meta-analysis of studies, comprising of 11,143 dementia-free individuals aged 65 years were included.<sup>32</sup> After a follow-up of mean 3.8 years, totalling 42,715 person-years. Pooling of results from all the countries found no significant association between tobacco intake and the onset of any dementia. It seems that selective quitting of tobacco may have biased the results towards negative results. A cohort study involving 3,933,382 subjects in Korea, they had mild to moderate alcohol intake.<sup>33</sup> Interestingly, alcohol intake was associated with a decreased risk of dementia compared with sustained nondrinking. Sustained heavy drinking of alcohol was associated with an increased risk of dementia. Decline in drinking from a heavy to a moderate level and initiation of mild drinking were associated with a decreased risk of dementia compared with a sustained level of drinking.<sup>33</sup> It is possible that the threshold of alcohol consumption for dementia risk reduction is low. Interestingly, religious service attendance and mental and spiritual health may be protective against all cause morbidity and mortality.<sup>35</sup> It seems that the development of an effective systemic health-care model for delivery of services to the families and patients with dementia keeping our sociocultural beliefs in mind may be useful.<sup>34-37</sup> Every step should be taken to improve awareness regarding dementia and its preventive measures, to halt the epidemic, thereby contributing to the sustainable development goals.<sup>1-4</sup>

## Conclusion

In conclusion, behavioural risk factors such as tobacco intake, alcoholism, sleep disruption, anxiety and low cognitive activity, western type diet, sedentary behaviour, lack of meditation and prayer have become a public health problem in causing dementia. It is possible that increased physical activity, no tobacco and alcoholism, optimal sleep, intake of healthy foods, high cognitive activity, and increase in meditation and prayer can protect against dementia.

## Compliance to ethics and informed consent

The authors have stated all possible conflicts of interest and all the sources of funding with this work. Informed consent was achieved from each subject and study was approved by the institutional ethic committee, in accordance with Helsinki declaration 1964.

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## Conflicts of interest

The authors declare that there is no conflict of interest.

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