

# Prevalence of major neurological disorders in predominantly rural northwest India

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## ABSTRACT

**Background:** Epidemiological studies based on hospital population, geographic isolates, smaller population, and focused groups provide valuable information on the pattern of diseases, but do not reflect on the true prevalence rates or the changing trends of disease over a period of time in different communities. The present study was undertaken to determine the prevalence and pattern of various neurological disorders in Himachal Pradesh. **Methodology:** Study was carried out in urban and rural population of district Kangra of Himachal Pradesh. A proportional representation was given to each area in the allocation of sample size as per probability proportional to size (PPS) method using a two-phase design: 1) A screening phase and 2) a clinical evaluation phase. All subjects were screened and a subset (screen positive and 10% of screen negative) was identified for the detailed clinical evaluation after screening. A standardized screening battery (NIMHANS protocol) was used for this purpose. An individual was confirmed as a case of neurological disorder only after clinical evaluation. **Results:** A total of 260 (out of 10,000 studied) individuals were found positive for neurological disorders yielding a crude prevalence of 2.6%. The crude prevalence for rural areas was found to be 2.28% (206/9000), whereas the crude prevalence in urban area was found to be 5.4% (54/1000). Migraine was the most common disorder. **Conclusion:** In view of the high crude prevalence of major neurological disorders, there is a need to develop capacity among healthcare professionals regarding them.

**Keywords:** Goiter zone, major neurological disorders, northwest India, prevalence

## Introduction

The global epidemiological transition has led to a shift in the disease pattern from infectious disease domination to one characterized by noncommunicable diseases (NCDs).<sup>[1]</sup>

Among the NCDs, neurological diseases share a significant proportion and have a devastating effect on patients because neurological disorders are the leading cause of disability and

the second leading cause of death worldwide.<sup>[2,3]</sup> Common neurological disorders have a social stigma attached with them. This serves as a major obstacle in identification, management, and counselling of the patients.<sup>[3]</sup> Added to this is the problem of integrating patients with neurological disorders in the community. Primary care has to play a large role in this.

A large number of neurological diseases are now included under the umbra of modification and cure. The spectrum of neurological disorders seen in India is largely similar to that of other parts of the world with some regional differences.<sup>[4]</sup>

In order to plan services in a socio-culturally appropriate and cost-effective manner, epidemiological data on neurological diseases form a basic prerequisite. Epidemiological studies based

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on hospital population, geographic isolates, smaller population, and focused groups provide valuable information on the pattern of diseases, but do not reflect on the true prevalence rates or the changing trends of disease over a period of time in different communities. Population-based studies are crucial for calculating the true prevalence in the communities to plan and organize effective neurological services.

## Methodology

This study was carried out in urban and rural population of district Kangra of Himachal Pradesh. Two health blocks of Shahpur and Nagrota Bagwan of Kangra district of Himachal Pradesh were taken as the rural population. The Kangra town with its 9 wards along with its slum population was the study area for urban population. A proportional representation was given to each area in the allocation of sample size as per probability proportional to size (PPS) method, which is generally adopted in carrying out large community-based studies.<sup>[5]</sup>

All residents (above 1 year of age) of the study area were the source population for the study. The study was carried out for a period of 1 year beginning June 2017. A sample size of 10,000 individuals was completed from the study areas. This sample helped us to arrive at the true prevalence of neurological disorders as has been shown by previous community-based studies on neurological disorders in India.<sup>[5]</sup>

Following factors were considered for calculating desired sample size.

- Considering the representation of population in rural: urban areas of Himachal Pradesh (90%: 10%), around 1000 individuals of sample number were selected from urban wards of Kangra town.
- The remaining sample of 9000 was selected from the two rural field practice areas of Shahpur and Nagrota Bagwan.

The study was conducted in two phases: 1) A screening phase and 2) a clinical evaluation phase. The screening phase also involved a detail of the sociodemographic profile of the study population. All subjects were screened and a subset (screen positive and 10% of screen negative) was identified for the detailed clinical evaluation after screening. A standardized screening battery (NIMHANS protocol) was used for this purpose.<sup>[3]</sup> The screening consisted of a cross-sectional comprehensive survey of all residents aged 1 year and older.

A house-to-house survey was conducted to identify individuals eligible for inclusion in the study.

All eligible individuals present in their homes on the day of survey and giving their consent to participate were included in the study. In this way, a total of 10,000 individuals were identified for the purpose of this study from selected geographical locations using the sampling technique as detailed above.

The interviews were conducted in participants homes with participants asked to provide informed written consent. Next of kin were asked to provide written agreement in the event of lack of capacity to consent and in case of children less than 18 years of age. A consent/assent form was completed for children more than 7 years of age.

## Clinical evaluation and diagnosis

All individuals returning positive on NIMHANS screen were considered as a suspect case of neurological disorder and were evaluated for clinical diagnosis. Furthermore, 10% of individuals returning negative on the screen were also evaluated clinically. The selection of these 10% individuals for clinical evaluation was similar to the process carried out for the purpose of screening for presence of neurological disorder. The clinical evaluation was carried out by a neurologist. The subjects were examined for the following major neurological disorders:

1. Stroke
2. Epilepsy
3. Dementia
4. Parkinsonism
5. Headache
6. Multiple Sclerosis
7. Cerebral Palsy

An individual was confirmed as a case of neurological disorder only after clinical evaluation.

## Sampling Design

### Rural area

The requisite sample of 9000 individuals from rural areas was selected, based on the principle of probability proportional to size by a two-stage random sampling method.

### Urban area

1000 individuals were picked up from urban area following the principle of probability proportional to size. The process was similar to the one followed in the rural area.

After assigning the population to be studied, households were systematically selected to complete the allocated sample size.

## Results

Of the total 10,000 screened during the first phase, the mean age in the rural area was 34.96 years (SD  $\pm$  20.88), whereas in the urban area was 35.86 years (SD  $\pm$  19.95). There was almost an equal gender wise distribution among the study population. Among the individuals from the rural areas, 63.48% of the individuals belonged to the lower middle class, whereas among the urban population, 69.5% of the individuals were from upper middle class. A total of 260 (out of 10,000 studied) individuals were found positive for neurological disorders yielding a crude prevalence of 2.6%. The crude prevalence for rural areas was

found to be 2.28% (206/9000), whereas the crude prevalence in urban area was found to be 5.4% (54/1000). Migraine was the most common disorder among both rural and urban areas with 117/9000 and 26/1000, i.e., 1.3% prevalence among rural individuals and 2.6% among urban individuals. The total prevalence of migraine was 143/10,000 (1.43%). The prevalence of epilepsy in the entire population was 48/10,000 (0.48%) with 37/9000 (0.41%) among the rural population and 11/1000 (1.1%) among the urban population. The other neurological disorders which included myasthenia gravis, facial palsy, brain tumor, LSMMC, Down's syndrome, and mental retardation showed a prevalence of 0.1%(10/10,000) [Table 1].

Table 2 provides details on the age wise prevalence of neurological disorders in the population. It is seen that among the age group of 7 years and above, migraine was found to be the most common disorder with a prevalence of 117/9000 (1.3%) among the rural and 26/1000 (2.6%) among the urban population. No case of migraine was detected below seven in the study population. Epilepsy and stroke were the next most common disorders in the age group of 7 years and above with a prevalence of 36/9000 (0.4%) and 33/9000 (0.36%), respectively, among the rural population and 10//1000 (1.0%) and 7/1000 (0.7%), respectively, among urban population. Among the age group of less than 7 years, only 1 patient of epilepsy each in the rural as well as urban population was found, whereas no patient of stroke was found in the rural as well as the urban population.

Table 3 provides the details on the gender wise prevalence of neurological disorders among the study population. It is seen that the prevalence of migraine was found to be higher among females 87/9000 (0.96%) in rural population as compared to males 30/9000 (0.33%); however, epilepsy 23/9000 (0.25%) and stroke 23/9000 (0.25%) were higher among the rural males as compared to females. The prevalence of dementia and other disorders was found almost similar in both the genders. Cerebral palsy was more among rural female population with a prevalence of 6/9000 (0.6%), whereas the prevalence of Parkinsonism was same (1/9000; 0.01%) in both the genders. Among the urban population, migraine was more prevalent among the females 24/1000 (2.4%) compared to males 2/1000 (0.2%). Epilepsy and stroke were more among males (9/1000;0.1% and 4/1000;0.4%, respectively) compared to females. There was 3/1000 (0.3%) cerebral palsy found among males; however, no patient of cerebral palsy was found among urban females. The prevalence of parkinsonism was same among males and females; however, dementia was found in 1/1000 (0.1%) urban males, whereas no case of dementia was discovered in urban females. Prevalence of other disorders among both the sexes was found to be 2/1000 (0.2%).

Table 4 provides the details on the socioeconomic status wise prevalence of neurological disorders in rural population. Among the rural population, migraine was prevalent only among the lower middle class 78/9000 (0.86%) and the upper lower class 39/9000 (0.43%). No cases of migraine were reported

**Table 1: Prevalence of neurological disorders in study population**

DIAGNOSIS	RURAL (n %)	URBAN (n %)	TOTAL (n %)
Migraine	117 (1.3)	26 (2.6)	143 (1.43%)
Epilepsy	37 (0.41)	11 (1.1)	48 (0.48%)
Stroke	33 (0.36)	7 (0.7)	40 (0.4%)
Cerebral Palsy	8 (0.08)	3 (0.3)	11 (0.11%)
Parkinsonism	2 (0.02)	2 (0.2)	4 (0.04%)
Dementia	3 (0.03)	1 (0.1)	4 (0.04%)
Others	6 (0.06)	4 (0.4)	10 (0.1%)
All disorders taken together	206 (2.28)	54 (5.4)	260 (2.6)

The figures in parenthesis are percentages.

**Table 2: Age wise prevalence of neurological disorders in the study population**

	RURAL (n %)		URBAN (n %)	
	<7 YEARS	>7YEARS	<7 YEARS	>7 YEARS
Migraine	0	117 (1.3)	0	26 (2.6)
Epilepsy	1 (0.01)	36 (0.4)	1 (0.1)	10 (1.0)
Stroke	0	33 (0.36)	0	7 (0.7)
CP	1 (0.01)	7 (0.07)	0	3 (0.3)
Parkinsonism	0	2 (0.02)	0	2 (0.2)
Dementia >5 Years	0	3 (0.03)	0	1 (0.1)
Others	0	6 (0.06)	0	4 (0.4)

The figures in parenthesis are percentages

**Table 3: Gender wise prevalence of neurological disorders among the study population**

Diagnosis	RURAL (n%)		URBAN (n%)	
	MALE	FEMALE	MALE	FEMALE
Migraine	30 (0.33%)	87 (0.96%)	2 (0.2%)	24 (2.4%)
Epilepsy	23 (0.25%)	14 (0.15%)	9 (0.9%)	2 (0.2%)
STROKE	23 (0.25%)	10 (0.11%)	4 (0.4%)	3 (0.3%)
Cerebral Palsy	2 (0.02%)	6 (0.6%)	3 (0.3%)	0 (0.0%)
Parkinsonism	1 (0.01%)	1 (0.01%)	1 (0.1%)	1 (0.1%)
Dementia >5 Years	2 (0.02%)	1 (0.01%)	1 (0.1%)	0 (0.0%)
OTHERS	3 (0.03%)	3 (0.03%)	2 (0.2%)	2 (0.2%)

The figures in parenthesis are percentages

**Table 4: Socioeconomic status wise prevalence of neurological disorders in rural population**

DIAGNOSIS	CLASS III (n %)	CLASS IV (n %)
Migraine	78 (0.86)	39 (0.43)
Epilepsy	22 (0.24)	15 (0.16)
Stroke	21 (0.23)	12 (0.13)
Cerebral Palsy	6 (0.06)	2 (0.02)
Parkinsonism	0	2 (0.02)
Dementia >5 Years	3 (0.03)	0
Others	4 (0.04)	1 (0.01)

among the upper, upper middle, and lower classes. Epilepsy with a prevalence of 22/9000 (0.24%) in the lower middle class and 15/9000 (0.16%) in the upper lower class was the second

most common disorder followed by stroke 21/9000 (0.23%) in lower middle class and 12/9000 (0.13%) in upper lower class was the third most common disorder. No neurological disorders are reported among the upper, upper middle, and lower classes.

Table 5 provides the details on the socioeconomic status wise prevalence of neurological disorders in urban population. Among the urban population, migraine was the most common disorders with the highest prevalence in upper middle class 19/9000 (1.9%). The upper and the lower middle class showed a prevalence of 3/1000 (0.3%) and 4/1000 (0.4%), respectively. Epilepsy was found to be highest among the upper middle class with a prevalence of 6/1000 (0.6%) as compared to lower middle class 3/1000 (0.3%) and upper lower 2/1000 (0.2%). No case of epilepsy was reported in the upper and lower classes. Highest prevalence of stroke was also reported among the upper middle class with a prevalence of 0.5%, while the upper and lower middle classes showed a prevalence of 0.1%. No case of stroke was reported among the upper lower or the lower group. Cerebral Palsy (CP) was reported only among the upper middle class with a prevalence of 0.03%. Parkinsonism was reported among the upper middle class and the upper lower class with a prevalence of 0.1% in both the classes. Dementia was reported among the lower middle class with a prevalence of 0.1%, while other neurological disorders were reported among the upper class (0.1% and the upper middle class (0.3%).

## Discussion

Our study revealed a crude prevalence of major neurological disorders at 2.6% (260/10,000) in the study population. Globally, the prevalence of neurological disorders has been estimated to be little lower than the estimates obtained by us for our study population.<sup>[6]</sup> However, our results are consistent with the crude prevalence rates for neurological disorders projected in studies carried out in India. The prevalence has been estimated to have varied from 0.9% to 4% (967–4070 per 100,000 population) with an average of 2.3% (2394 per 100,000 population).<sup>[7]</sup>

The prevalence of neurological disorders in our study was higher among females in both study populations, i.e., the rural (122/9000;1.35%) and urban (32/1000;3.2%) population. In contrast as per Das and Sanyal, in Kolkata, the prevalence of neurological disorders was more in males as compared to

females.<sup>[5]</sup> But similar to the findings of our study, the studies by Gourie Devi *et al.* and Das and Sanyal in Bangalore and Malda, respectively, the prevalence rate was higher in females than males.<sup>[8,9]</sup> A higher prevalence of migraine headache (as a contributor to neurological disorders) in our study could be one of the reasons for higher prevalence of neurological disorders in our female population. Women suffer from migraine three times as often as men. 85% of chronic migraine sufferers are women.<sup>[10]</sup> It has also been observed that relatively higher prevalence of neurological disorders among women may be due to greater survivability of Indian women.<sup>[11]</sup>

Global Burden Study (year 2010) reported a migraine prevalence of 14.70%.<sup>[12]</sup> Some of the previous migraine prevalence reported include Karnataka 25.2% and northern India 13.44%.<sup>[13,14]</sup> Migraine appears less prevalent, but still common, elsewhere in Asia (around 8%) and in Africa (3%–7% in community-based studies).<sup>[15]</sup> As per our study, the crude prevalence of migraine was estimated at 1.43% (143/10,000), which was lesser than some other studies conducted across the world. Our results, however, were similar to the estimates obtained by Gourie Devi *et al.* wherein the prevalence of headache was estimated at 967 per 100,000 (0.96%) in the urban area and in rural areas, the estimates came at 1259 per 100,000 (1.26%).<sup>[10]</sup> The lower prevalence could be attributed to the age distribution of the study population with migraine being more prevalent in higher age group. This may also be the reason that our results are similar to the study by Gourie Devi *et al.*, a population-based neuro-epidemiological survey of 102,557 individuals in urban and rural Bangalore in southern India.

The overall prevalence of epilepsy has been seen to range from 2.7 to 41 per 1000 population, though in the majority of reports, the rate of active epilepsy (i.e., at least one seizure in the preceding 5 years) is in the range 4–8 per 1000.<sup>[16,17]</sup> The crude prevalence rate has been seen to vary from 2.2–10.4 per 1000 population in studies conducted across India. The concerns have been the small sample size in all, except one, of these studies and the definition of epilepsy was not included. Our study population was representative of all age groups, a possible cause for lower estimates for epilepsy. This may also be the reason that our estimates are similar to the estimates of Bangalore study which gave prevalence estimates of 883/100,000 (0.88%).<sup>[10]</sup>

In our study, the prevalence of stroke was 40/10,000 (0.4%). The prevalence estimates from our study are almost comparable to the estimates obtained from other studies conducted across India.

According to the India stroke factsheet updated in 2012, the estimated age-adjusted prevalence rate for stroke ranges between 84/100,000 and 262/100,000 (0.084%–0.26%) in rural and between 334/100,000 and 424/100,000 (0.33%–0.42%) in urban areas.<sup>[18]</sup>

In our study, the crude prevalence rate for stroke in urban area was 7/1000 (0.7%), while in rural areas, it was estimated

**Table 5: Socioeconomic status wise prevalence of neurological disorders in urban population**

	I	II	III	IV
MIGRAINE	3 (0.3)	19 (1.9)	4 (0.4)	0
EPILEPSY	0	6 (0.6)	3 (0.3)	2 (0.2)
STROKE	1 (0.1)	5 (0.5)	1 (0.1)	0
CP	0	3 (0.3)	0	0
PARKINSONISM	0	1 (0.1)	0	1 (0.1)
DEMENTIA >5 YEARS	0	0	1 (0.1)	0
OTHERS	1 (0.1)	3 (0.3)	0	0

at 33/9000 (0.36%). Higher prevalence in urban compared to rural regions has been reported in South Asia.<sup>[19]</sup> To a certain extent, this wide variation can be explained by differences in the age structure of population; however, there could be genuine regional differences due to the degree and nature of risk factors. Even allowing for these variations, a matter of concern is that in the last two decades, there is a significant increase in prevalence rate of stroke. Pooled analysis through forecasting method has shown that the estimated prevalence rates of stroke for the years 2000 and 2015 are 108 and 133 per 10,000 population, respectively, indicating a dramatic rise in prevalence of stroke over a period of 15 years, and by 2015, it is estimated that there will be 1,667,372 cases of stroke in India.<sup>[20]</sup>

Globally, CP prevalence data show some geographic differences, but overall, population-based reports have shown a fairly stable rate among the term group at 1 to 1.5 per 1000 live births.<sup>[21,22]</sup> In our study, prevalence of CP was 11 per 10,000 (0.11%). The prevalence was more in urban area (0.3%) as compared to rural area 8/9000 (0.08%); in urban setting, no case was reported among females, while 3 cases (0.3%) of CP were reported among males. A cross-sectional study by Raina *et al.* in Jammu and Kashmir reported 2.77 per 1000 in age group of less than 10 years of age. The proportion of cerebral palsy occurring in males was higher than that in females.<sup>[22]</sup>

Several urban and rural studies on dementia from different parts of India had documented lower rates varying from 1.02% to 3.36% above 60 to 65 years of age.<sup>[23-25]</sup>

In our study, the crude prevalence rate of dementia was 4/10,000 (0.04%); in urban area, the prevalence was 1/1000 (0.1%), while in rural area, the prevalence was 3/9000 (0.03%). In both rural and urban areas, the prevalence of dementia was more in males in comparison to females 2:1 and 1:0, respectively. A lower prevalence in our case is attributable to the wide population distribution of our study population, while most other studies have focused on elderly population. An age adjusted population distribution may provide a better picture on the prevalence estimate.

Among the movement disorders, epidemiology of Parkinson's disease has been better studied than other disorders in India. Population-based surveys (excluding Parsis) have shown a crude prevalence rate (CPR) of Parkinson's disease varying from 6–53/100,000.<sup>[8]</sup> An epidemiological study by Das *et al.* showed a crude prevalence of 45.8 per 100,000 of Parkinsonism.<sup>[26]</sup> In our study, the crude prevalence rate for parkinsonism was 4/10,000 (0.04%). The prevalence in rural area is 2/9000 (0.02%), whereas in urban setting, the prevalence is 2/1000 (0.2%). Male to female ratio was same in both rural and urban setting, i.e., 1:1. A meta-analysis of studies on Parkinson's disease from 1985 to 2010 by Pringsheim *et al.* reported that the prevalence of PD among males and females in Asia was 371 and 306 per 100,000 population, while the prevalence in Europe, north America, and Australia was 1535 and 1267 per 100,000 males and females, respectively.<sup>[27]</sup>

The low prevalence of PD in India (with the exception of Parsi population) compared to the Western countries is at variance with the interesting observations made through a meticulous study by Muthane *et al.* that normal human brains in India have 40% lower number of melanized neurons in substantia nigra compared to brains in United Kingdom.<sup>[28]</sup>

Undiagnosed PD in the elderly is a problematic issue in many countries and the patients, therefore, do not have the benefit of treatment and necessary health care services.

Determination of risk factors in PD is difficult in the absence of a biological marker, its occurrence in the elderly, and relative infrequency.

## Conclusions

The burden of neurological diseases is on the increase in India, while policymakers and administrators continue to perceive neurological problems to be mainly urban. With limited specialized workforce, the task of providing neurological care to Indians is daunting. Therefore, there is an urgent need to task shift through building capacity in primary care.

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## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

## References

1. Thakur JS. Public Health Approaches to Non- Communicable Diseases. India: Wolters Kluwer Health; 2015.
2. GBD 2016 Neurology Collaborators. Global, regional, and national burden of neurological disorders, 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016. *Lancet Neurol* 2019;18:459-80.
3. Devi G. Neuroepidemiology in Developing Countries. Bangalore: Prism Books Pvt Ltd; 1997.
4. Khadilkar SV. Neurology: The Scenario in India. *J Assoc Physicians India* 2012;60:42-4.
5. Nagar S, Juyal RC, Chaudhary S, Behari M, Gupta M, Rao SN, *et al.* Mutations in the alpha-synuclein gene in Parkinson's disease among Indians. *Acta Neurol Scand* 2001;103:120-2.
6. GBD 2016 Dementia Collaborators. Global, regional, and nationalburden of Alzheimer's disease and other dementias,

- 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016. *Lancet Neurol* 2019;18:88-106.
7. Gourie-Devi M. Epidemiology of neurological disorders in India: Review of background, prevalence and incidence of epilepsy, stroke, Parkinson's disease and tremors. *Neurol India* 2014;62:588-98.
  8. Gourie-Devi M, Gururaj G, Satishchandra P, Subbakrishna DK. Prevalence of neurological disorders in Bangalore, India: A community-based study with a comparison between urban and rural areas. *Neuroepidemiology* 2004;23:261-8.
  9. Das SK, Sanyal K. Neuroepidemiology of major neurological disorders in rural Bengal. *Neurol India* 1996;44:47-58.
  10. Migraine is a women's health issue. Available from: <https://americanmigrainefoundation.org/resource-library/migraine-in-women>. [Last accessed on 2019 Sep 24].
  11. Census of India. Registrar General and Census commissioner. Indian Census Report; 2001. Available online at: "<https://censusindia.gov.in/>" [Last accessed on 2019 Jun 12].
  12. Murray CJ, Vos T, Lozano R, Naghavi M, Flaxman AD, Michaud C, *et al.* Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: A systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 2013;380:2197-223.
  13. Kulkarni GB, Rao GN, Gururaj G, Stovner LJ, Steiner TJ. Headache disorders and public ill-health in India: Prevalence estimates in Karnataka State. *J Headache Pain* 2015;16:67.
  14. Nanda R, Chahabra MK. Prevalence and clinical characteristics of headache in dental students of a tertiary care teaching dental hospital in Northern India. *Int J Basic Clin Pharmacol* 2013;2:51-5.
  15. Scher AI, Stewart WF, Lipton RB. Migraine and headache: A meta-analytic approach. In: Crombie IK, editor. *Epidemiology of Pain*. Seattle, WA: IASP Press; 1999. p. 159-70.
  16. Hauser WA. Incidence and prevalence. In: Engel J Jr, Pedley TA, editors. *Epilepsy: A Comprehensive Textbook*. Philadelphia, PA: Lippincott-Raven; 1997. p. 47-57.
  17. Gourie-Devi M. Epidemiology of neurological disorders in India: Review of background, prevalence and incidence of epilepsy, stroke, Parkinson's disease and tremors. *Neurol India* 2014;62:588-98.
  18. Stroke fact sheet India. Available from: <http://www.sanecd.org/Updated%20Stroke%20Fact%20sheet%202012.pdf>. [Last accessed on 2019 Sep 24].
  19. Kulshreshtha A, Anderson LM, Goyal A, Keenan NL. Stroke in South Asia: A systematic review of epidemiologic literature from 1980 to 2010. *Neuroepidemiology* 2012;38:123-9.
  20. Indrayan A. Forecasting Vascular Disease Cases and Associated Mortality. *Burden of Disease in India*. New Delhi: National Commission on Macroeconomics and Health, Ministry of Health and Family Welfare, Government of India; 2005. p. 197-218.
  21. Topp M, Uldall P, Greisen G. Cerebral palsy births in eastern Denmark, 1987-90: Implications for neonatal care. *Paediatr Perinat Epidemiol* 2001;15:271-7.
  22. Raina SK, Razdan S, Nanda R. Prevalence of cerebral palsy in children <10 years of age in R.S. Pura Town of Jammu and Kashmir. *J Trop Pediatr* 2011;57:293-5.
  23. Shaji S, Bose S, Verghese A. Prevalence of dementia in an urban population in Kerala India. *Br J Psychiatr* 2005;186:136-40.
  24. Chandra V, Ganguli M, Pandav R, Johnston J, Belle S, DeKosky ST. Prevalence of Alzheimer's disease and other dementias in rural India: The Indo-US study. *Neurology* 1998;51:1000-8.
  25. Raina SK, Raina S, Chander V, Grover A, Singh S, Bhardwaj A. Is dementia differentially distributed? A study on the prevalence of dementia in migrant, urban, rural, and tribal elderly population of himalayan region in northern India. *N Am J Med Sci* 2014;6:172-7.
  26. Das SK, Misra AK, Ray BK, Hazra A, Ghosal MK, Chaudhuri A, *et al.* Epidemiology of Parkinson's disease in the city of Kolkata, India: A community-based study. *Neurology* 2010;75:1362-9.
  27. Pringsheim T, Jette N, Frolkis A, Steeves TDL. The prevalence of Parkinson's disease: A systematic review and meta-analysis. *Mov Dis* 2014;29:1583-90.
  28. Muthane U, Yasha TC, Shankar SK. Low numbers and no loss of melanized nigral neurons with increasing age in normal human brains from India. *Ann Neurol* 1998;43:283-7.