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Best Practice & Research Clinical Rheumatology

journal homepage: www.elsevierhealth.com/berh



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The epidemiology of neck pain

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Keywords:

neck pain
epidemiology
incidence
prevalence
remission
recurrence
duration

Neck pain is becoming increasingly common throughout the world. It has a considerable impact on individuals and their families, communities, health-care systems, and businesses. There is substantial heterogeneity between neck pain epidemiological studies, which makes it difficult to compare or pool data from different studies. The estimated 1 year incidence of neck pain from available studies ranges between 10.4% and 21.3% with a higher incidence noted in office and computer workers. While some studies report that between 33% and 65% of people have recovered from an episode of neck pain at 1 year, most cases run an episodic course over a person's lifetime and, thus, relapses are common. The overall prevalence of neck pain in the general population ranges between 0.4% and 86.8% (mean: 23.1%); point prevalence ranges from 0.4% to 41.5% (mean: 14.4%); and 1 year prevalence ranges from 4.8% to 79.5% (mean: 25.8%). Prevalence is generally higher in women, higher in high-income countries compared with low- and middle-income countries and higher in urban areas compared with rural areas. Many environmental and personal factors influence the onset and course of neck pain. Most studies indicate a higher incidence of neck pain among women and an increased risk of developing neck pain until the 35–49-year age group, after which the risk begins to decline. The Global Burden of Disease 2005 Study is currently making estimates of the global burden of neck pain in relation to impairment and activity limitation, and results will be available in 2011.

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Neck pain is a common condition, which causes substantial disability and economic cost [1]. While much of the epidemiological literature on neck pain varies significantly with respect to methodology, which limits the ability to compare and pool data across studies, data consistently show that neck pain is widespread throughout many regions of the world, and appears to be increasing in both the general population and specific occupational groups [1].

In assessing health priorities, allocating resources and evaluating the potential costs and benefits of public health interventions, governments consider the burden of a disease and its contribution to the overall health of the population relative to other diseases [2]. Burden of disease rankings are based on how much death and disability each disease causes. Global Burden of Disease (GBD) studies provide these rankings for the world and its major regions.

The GBD 2005 study (GBD 2005) is currently being undertaken to estimate the 2005 burden for more than 175 diseases and injuries [3]. The methods used will also be retrospectively applied to 1990 data to revise the original GBD estimates [3,4]. This is the first time the global burden of neck pain has been assessed using burden of disease methods. Epidemiological parameters, such as prevalence, incidence and remission, are important in the estimation of disease burden. In this article, we describe the process we have adopted to identify data for estimating the global burden of neck pain for GBD 2005. We briefly present a summary of our results together with an overview of the neck pain epidemiological literature.

Case definition

There is extensive variation in the way neck pain is defined in the literature [5]. For the purposes of GBD 2005, the case definition for neck pain needed to be aligned with the epidemiological literature on neck pain to ensure we had sufficient data to support our estimates. The Bone and Joint Decade 2000–2010 Task Force on Neck Pain and its Associated Disorders (BJD–TF–NP) recently conducted a series of reviews of the epidemiological literature, and found more than 300 case definitions for neck pain [5]. In particular, they found variation regarding the specific anatomical region under study and the recall period used. Some studies made estimates for pain in the ‘neck’, while others made estimates for pain in the ‘neck or shoulder’ region, ‘neck or upper thoracic’ region or some other variation. Some provided a diagram to specifically indicate the region that was being studied, while others did not, and some prevalence studies made estimates of ‘current’ neck pain (point prevalence), some made estimates of period prevalence (e.g., one-year, lifetime and so on), and others provided estimates of both point and period prevalence.

The Task Force proposed a framework for defining neck pain in epidemiological studies. This consists of five axes which they recommend are clearly described when reporting on the studies: (1) the source of subjects and data; (2) the setting or sampling frame; (3) the severity of neck pain and its consequences; (4) the duration of neck pain; and (5) its pattern over time [5]. They also recommended studies use a standardised anatomical case definition for neck pain [5].

Using the five axes described above, we sought epidemiological data from surveys that had mainly focussed on the general population; we included any mildly, moderately or severely activity-limiting neck pain; and the minimum duration of an episode was set at 1 day to exclude trivial pain. For the purpose of GBD 2005, we used the following case definition: ‘Activity-limiting neck pain (\pm pain referred into the upper limb(s)) that lasts for at least 1 day.’ We used the anatomical definition as recommended by the (BJD–TF–NP) and we included cases that had pain in other areas, such as the head and trunk, provided pain was present in the neck [5]. We assumed ‘neck or shoulder’ pain is a proxy for ‘neck’ pain.

For case definitions that differed from this, we used a Bayesian function of a program called DisMod III to convert these to our GBD case definition. This will be reported on in more detail in a later publication.

Functional health states

We developed a set of discrete health states to describe the severity levels and disabling consequences of neck pain. These were chosen and defined according to the natural history of neck pain, identification of paths within that natural history that result in a significant loss of functioning and the

availability of sufficient epidemiological data on these health states to enable their use in the calculation of the burden of neck pain.

The International Classification of Functioning, Disability and Health (ICF) states that disability may constitute impairments of body functions and structures, activity limitations and/or participation restrictions [6]. While loss of function in burden of disease terminology can be defined as any departure from an 'ideal health state', for the purpose GBD 2005, functional loss is limited to impairments of body structures and functions and activity limitation. The GBD methods do not take into account burden that may result from broader constructs, such as participation, well-being, increased pressure on health-care systems or economic cost, and this needs to be considered when interpreting burden of disease study results. With regard to activity limitation, we attempted to count 'any' activity-limiting neck pain, irrespective of whether it was mildly, moderately or severely activity-limiting.

Similar to other diseases in GBD 2005, it was not possible for us to list every imaginable health state for neck pain due to the time and resources required for estimating burden for each of these. As such, only the most common health states causing the greatest burden were selected. Each was defined in technical and lay terms according to a specific set of domains relating to bodily impairment and activity limitation. A health state value was derived through community and health professional surveys to reflect the severity of each of the health states on a continuum between zero (equivalent to full health) and one (equivalent to death). Lay descriptions had to be concise as pre-testing found lengthy descriptions often confused survey participants. The health states for neck pain are shown in Table 1.

Descriptive epidemiology

The major indicators of disease occurrence at a population level are incidence (number of new cases of a disease in a given time period) and prevalence (number of individuals with existing disease at a given point in time) [7]. Most people experience neck pain at some stage in their lives [8]. Neck pain is usually first experienced in childhood or adolescence [1,9,10], and, like low back pain, runs an episodic course over a person's lifetime [5,11]. Therefore, estimating the incidence of neck pain is problematic, as the cumulative incidence of first-ever episodes of neck pain is already high by early adulthood [12], and symptoms tend to recur over time [13].

In addition, fewer incidence studies have been performed as these are expensive and require longitudinal studies in comparison to cheaper cross-sectional studies that can be performed to measure prevalence. There is also substantial methodological variation between neck pain incidence

Table 1

The health states for neck pain in GBD 2005.

Health state	Technical definition	Lay description
Acute neck pain with arm pain	Activity-limiting neck pain (with pain referred into either upper limb) that lasts for at least one day and resolves either temporarily or permanently in less than three months.	This person has severe neck pain, and difficulty turning the head and lifting things. The person gets headaches and arm pain, sleeps poorly, and feels tired and worried.
Acute neck pain without arm pain	Activity-limiting neck pain (with no pain referred into either upper limb) that lasts for at least one day and resolves either temporarily or permanently in less than three months.	This person has neck pain, and difficulty turning the head and lifting things.
Chronic neck pain with arm pain	Activity-limiting neck pain (with pain referred into either upper limb) that lasts for three months or more.	This person has constant neck pain and arm pain, and difficulty turning the head, holding arms up, and lifting things. The person gets headaches, sleeps poorly, and feels tired and worried.
Chronic neck pain without arm pain	Activity-limiting neck pain (with no pain referred into either upper limb) that lasts for three months or more.	This person has constant neck pain and difficulty turning the head, holding arms up, and lifting things.

studies with differences in the length of the follow-up period; baseline inclusion criteria; the case definition, including the anatomical location of neck pain and the minimum duration of the episode; and whether the number of people with one or more neck pain episodes, or the number of episodes, including repeat episodes in one individual, were being counted.

As part of GBD 2005, we conducted systematic reviews to determine the incidence, remission and prevalence of neck pain throughout the world. For each of these reviews, we searched Ovid Medline, Embase, Cinahl, CAB abstracts, WHOLIS and SIGLE databases. We sought both published and unpublished population-based studies published or performed from 1980 to 2009 inclusive. There were no language, age, gender or setting restrictions. Reference lists of the full articles retrieved for further assessment were also examined to identify additional potentially relevant articles. Studies were excluded, if they were not representative of the population as a whole (e.g., judo athletes, pregnant women, miners, military, etc., or hospital- or clinic-based); provided no prevalence, incidence or remission data (e.g., a commentary piece, risk factor analysis, and so on); included only a specific subset of neck pain sufferers; had a sample size less than 150; or were reviews.

We developed a tool to assess the risk of bias of the included studies [14]. In brief, the tool was modified from an existing checklist developed by Leboeuf-Yde and Lauritsen to assess the methodological quality of epidemiological surveys reporting on the occurrence of low back pain [15]. The final risk of bias tool consisted of 10 items. Response options for each item were low and high risk of bias. Each study was also given an overall rating of high, moderate or low risk of bias. The tool was found to have a high level of inter-rater agreement (overall agreement 93%, Kappa statistic 0.83; agreement for individual items ranged from 83% to 100%, Kappa statistics 0.43–1.0) [14].

Incidence of neck pain

The following terms were used to identify studies for the systematic review of the incidence of neck pain in the general population: 'neck pain', 'neck ache', 'neckache' and 'cervical pain' individually and combined with each of the following: 'incidence', 'cohort study' and 'longitudinal study'.

Five studies met our inclusion criteria [9,16–19]. One was considered to have a moderate risk of bias [17], and the other four high risk of bias [9,16,18,19]. All studies measured recurrences as well as first-ever episodes of neck pain, and all measured the number of people with an episode of neck pain as opposed to the number of episodes. The 1 year incidence of neck pain measured in four studies ranged from 10.4% to 21.3% (Table 2).

Previous reviews have found that the incidence of neck pain varies between occupations. Côté et al. determined that office and computer workers had the highest incidence of neck disorders with an annual incidence of neck pain of 57% of asymptomatic office workers in the USA, 36% of Swedish municipal administrative workers and 34% of Finnish municipal employees [20]. They also reported a high incidence of neck pain in health-care workers and transit operators [20].

Remission of neck pain

Disease burden for the purpose of GBD 2005 is calculated according to the following formula: Disability-Adjusted Life Years (DALYs) = Years of Life Lost (YLL) + Years of Life lived with a Disability (YLD), where $YLD = \text{incidence} \times \text{duration} \times \text{disability weight}$. If incidence and duration are unavailable or the data are not robust, then DisMod III is used to derive these parameters [3]. DisMod III requires at least three of the following parameters to produce estimates for incidence and/or duration: prevalence, remission, duration, incidence, relative risk mortality, case fatality and cause-specific mortality.

For the purpose of estimating burden of disease for GBD 2005, remission is defined as the rate at which people stop having the disease, for example, by means of a cure. If a chronic-episodic view is taken, remission using this definition is often zero, that is, the person continues having the disease until they die despite inter-episodic periods of lesser or no disability. However, many neck pain epidemiological studies consider remission to be the transition into an asymptomatic state, regardless of whether the person has subsequent episodes at some point in the future. This is being taken into account when interpreting neck pain remission data for use in GBD 2005.

Table 2
One-year incidence of neck pain in the general population.

Citation	Country	Age range (years)	Inclusion criteria at baseline	Case definition ^a	Incidence (%)	Standard error (%)	Risk of bias
Ehrmann Feldman et al. [18]	Canada	10 to 14	No neck pain at least once/week over previous six months	Neck pain at least once a week over previous six months	10.4	1.9	High
Stahl et al. [9]	Finland	9 to 12	Seldom or no neck pain over previous three months	Neck pain at least once a month over previous three months	21.3	3.0	High
Croft et al. [16]	United Kingdom	18 to 75	No neck pain	Neck pain	17.9	1.3	High
Côté et al. [17]	Canada	20 to 69	No neck pain	Neck pain	13.3	1.5	Moderate

^a Definition of a new episode of neck pain.

For the systematic review of remission of neck pain, the following terms were used: 'neck pain', 'neck ache', 'neckache' and 'cervical pain' individually and combined with each of the following: 'duration', 'remission', 'cohort study' and 'longitudinal study'.

No population-based studies that met our inclusion criteria and provided relevant information on the remission of neck pain were identified. We therefore broadened our inclusion criteria to include study populations derived from clinic or health-care facilities. Using this strategy, we identified five studies; four from the Netherlands [11,21–23] and one from Sweden [24]. One of the studies was considered to have an overall low risk of bias [22], and the other four studies had a moderate risk of bias [11,21,23,24].

The studies varied with respect to the inclusion criteria at baseline, the case definition of neck pain and follow-up times, which varied from 6 weeks to 5 years. The average time between onset of pain and consultation was also unclear in most of the studies, making it difficult to accurately estimate the time to remission. We also noted that cases with continued neck pain at a particular follow-up time point (e.g., 6 months) might have had asymptomatic periods between this point and the baseline or other follow-up points. This may result in an underestimation of remission. Data from four studies indicated that remission at 1 year ranged from 33% to 65% (Table 3).

A previous review of the course and prognosis of neck pain found that most (50–85%) people, who experience an episode of neck pain, will report neck pain 1–5 years later [26]. One study found 48% of children with weekly or more neck pain reported at least the same pain severity 1 year later [27]. Hill et al. reported that 48% of general practice patients, who present with neck pain lasting 1 day or longer over the previous month, have pain of at least the same frequency 1 year later [28].

Prevalence of neck pain

Epidemiological studies on neck pain prevalence estimate either point (i.e., current) or period prevalence (e.g., over the last month, year and lifetime). Comparing the prevalence of neck pain between populations and over time is challenging due to considerable methodological heterogeneity across studies and difficulties in obtaining true population estimates.

Table 3
One-year remission from neck pain in health-care facility and clinic-based studies.

Citation	Country	Age range (years)	Definition of what is being counted at follow-up	Remission (%)	Standard error (%)	Risk of bias
Enthoven et al. [24]	Sweden	18 to 60	Recovery from pain and disability	55	2.8	Moderate
Bot et al. [11]	Netherlands	18+	Perceived recovery	33	2.5	Moderate
Hoving et al. [25]	Netherlands	18 to 70	Perceived recovery	65	3.6	Moderate
Vos et al. [23]	Netherlands	18+	Perceived recovery	46	4.2	Moderate

Much of the methodological variation relates to the case definition and recall period that is used, the age and sex distributions, the representativeness of the sample, the overall sample size, validation of the instrument used to measure prevalence, whether random methods were used in selecting the sample population, the extent of non-response and whether any measures were taken to deal with non-response bias.

We have already discussed case definition variations relating to the anatomical area being studied. Other variations relate to the minimum amount of time a person needs to have had neck pain to be counted, whether 'all' neck pain or just 'activity-limiting' neck pain is being counted and the frequency of symptoms.

For the systematic review of prevalence of neck pain, the following terms were used: 'neck pain', 'neck ache', 'neckache' and 'cervical pain' individually and combined with each of the following: 'prevalen*', 'inciden*', 'cross-sectional', 'cross-sectional', 'epidemiol*', 'survey', 'population-based', 'population-based', 'population study' and 'population sample'.

Seventy-five studies, which fulfilled our inclusion criteria, were identified. These were from 33 countries. Seven studies were considered to have a low risk of bias, 38 studies a moderate risk of bias and 30 studies a high risk of bias. Table 4 presents the prevalence from the 28 studies that were considered to

Table 4
The unadjusted prevalence of 'any' neck pain in the general population, by country.

Citation	Country	Age range (years)	Prevalence (%)	Standard error (%)	Risk of bias
<i>Point prevalence</i>					
Chaiannuay et al. [29]	Thailand	15 to 90	3.3	0.5	Low
Chiu et al. [30]	China, Hong Kong	15 to 99	12.2	1.3	Moderate
Chopra et al. [31]	India	15 to 99	6.0	0.4	Moderate
Côté et al. [32]	Canada	20 to 69	22.7	1.2	Moderate
Manahan et al. [33]	Philippines	15 to 99	6.8	0.8	Moderate
<i>One-week prevalence</i>					
Cardon et al. [34]	Belgium	8 to 12	10.5	1.6	Moderate
<i>Two-week prevalence</i>					
Fejer et al. [35]	Denmark	20 to 72	31.7	0.7	Low
<i>Three-week prevalence</i>					
Friedrich et al. [36]	Austria	15 to 99	22.0	1.9	Moderate
<i>One-month prevalence</i>					
Diepenmaat et al. [37]	Netherlands	12 to 16	11.5	0.5	Moderate
Lacey et al. [38]	United Kingdom	18 to 75	50.5	0.7	Moderate
Makela et al. [39]	Finland	30 to 99	41.1	0.8	Low
Sim et al. [40]	United Kingdom	18 to 75	24.0	0.6	Moderate
Thomas et al. [41]	United Kingdom	50 to 99	20.5	0.5	Moderate
Urwin et al. [42]	United Kingdom	16 to 99	16.6	0.5	Moderate
Webb et al. [43]	United Kingdom	16 to 99	13.8	0.5	Moderate
<i>Three month prevalence</i>					
Strine et al. [44]	USA	18 to 99	4.4	0.1	Moderate
<i>Six month prevalence</i>					
Bassols et al. [45]	Spain	18 to 99	31.8	1.1	Moderate
<i>One-year prevalence</i>					
Bergman et al. [46]	Sweden	20 to 74	19.0	0.8	Moderate
Bovim et al. [47]	Norway	18 to 67	34.4	0.5	Low
Ektor-Andersen et al [48]	Sweden	45 to 59	73.0	0.5	Moderate
Fredriksson et al. [49]	Sweden	42 to 59	17.4	2.4	Moderate
Hertzberg et al. [50]	Norway	25 to 28	30.2	2.7	Moderate
Linton et al. [51]	Sweden	35 to 45	66.3	1.0	Moderate
Palmer et al. [52]	United Kingdom	16 to 64	33.7	0.4	Moderate
Takala et al. [53]	Finland	40 to 64	17.1	1.1	Moderate
Westerling et al. [54]	Sweden	18 to 65	18.1	0.8	Moderate
<i>Lifetime prevalence</i>					
Cunningham et al. [55]	USA	25 to 74	5.6	0.4	Moderate
Dai et al. [56]	China	15 to 99	3.5	0.2	Moderate

have a low or moderate risk of bias and that presented unstandardised prevalence for their total sample (the reference list of the other studies is available upon request). The overall prevalence of neck pain in the general population ranged between 0.4% and 86.8% (mean: 23.1%); point prevalence ranged from 0.4% to 41.5% (mean: 14.4%); and 1 year prevalence ranged from 4.8% to 79.5% (mean: 25.8%) (Table 4). Due to the heterogeneity of the data, the mean estimates need to be interpreted with caution.

The mean overall prevalence was 27.2% in females and 17.4% in males. In high-income countries, the overall prevalence ranged from 0.4% to 86.8% (mean: 26.3%), while in low- and middle-income countries, it ranged from 0.8% to 80.0% (mean: 17.5%). In children and adolescents, the overall prevalence ranged from 8.7% to 78% (mean: 33.4%) and, in adults, it ranged from 0.4% to 86.8% (mean: 21.9%). Prevalence ranged from 0.4% to 86.8% in urban areas (mean: = 20.7%) and from 0.8% to 80.0% in rural areas (mean: 17.0%).

In another review of the epidemiology of neck pain, Hogg-Johnson et al. found that the 12-month prevalence of neck pain in the general adult population and workers ranged from 12.1% to 71.5%, while the annual prevalence among children ranged between 34.5% and 71.5% [1,57] (Table 4). Most studies have verified that the prevalence of neck pain increases with age, peaks in the 35–49-year age group and then begins to decline. Most evidence indicates a higher prevalence of neck pain among women compared with men [1,57].

It has been reported that 'activity-limiting' neck pain has a lower prevalence than 'any' neck pain [1,57]. In our systematic review, three general population studies had made estimates for both 'all' neck pain and neck pain that was 'moderately or severely activity-limiting'. Studies in the USA and Norway found that 17% and 19% of people, respectively, with neck pain had moderate to severe activity limitation [55,58]. Another study in the UK found that 70% of all neck pain was moderate to severely activity-limiting [41]. We found two general population studies, both performed in the UK, which estimated the prevalence of 'all' neck pain and neck pain that 'limits normal duties' [52,59]. One study reported that 33% of people with neck pain over the past year experienced limitations to their normal duties [52], and the other revealed that 69% of people with neck or upper limb pain over the past week found their normal activities difficult or impossible [59].

Neck pain related to whiplash-associated disorders (WADs) most commonly results from motor-vehicle accidents [57]. From a global perspective, the number of people presenting to hospitals with traffic-related WADs has been increasing over the past 30 years [8]. While pain in the neck and upper limbs are the most common symptom of WADs, other symptoms include headache, stiffness, shoulder and back pain, numbness, dizziness, sleeping difficulties, fatigue and cognitive deficits [57]. Occupational neck pain is also a common phenomenon, with the annual prevalence estimated to range from 16.5% in production-line workers in Lithuania [60] to 74.0% in crane operators in Sweden [61].

Risk factors and prognostic factors

There is widespread agreement that many environmental and personal factors influence the onset and course of neck pain [5,8]. Some of these are modifiable and some are not. As noted above, most, but not all studies have identified an association between age and the onset of neck pain [1,11], while most, but not all, studies have found a higher incidence of neck pain among women [1]. Having a history of neck or low back pain, poor self-assessed health and poor psychological status have also been found to increase the risk of neck pain onset [1,26]. Other evidence suggests that occupation, headaches, emotional problems, low job satisfaction, sedentary work postures, a poor physical work environment (e.g., poor keyboard or mouse position), ethnicity and smoking may be associated with the onset of neck pain [8,20].

There are varied results regarding gender as a prognostic factor for neck pain. Carroll et al. found two studies that indicated men are more likely to have remitted from neck pain over a 1- and 5-year period [17,62]; however, they found three further studies that indicated no gender difference in remission of neck pain [11,26,28,63]. Studies consistently show that younger age groups have an increased likelihood of remission from neck pain compared with older age groups [26]. Other factors associated with poor neck pain outcomes include a previous neck injury, high pain intensity, self-perceived poor general health, worrying, fear avoidance and getting angry or frustrated [26].

Impacts and outcomes

Neck pain and its related disability have a huge impact on individuals and their families, communities, health-care systems and businesses [5,8,57]. Individuals may have difficulties with many activities, such as driving a car, turning the head and working on a computer. They may also have a reduced ability to participate in work, social and sporting endeavours [57], which in turn can further increase the burden associated with neck pain.

The impacts and outcomes from neck pain are likely to vary significantly between and within populations depending on socioeconomic status, general access to health services, occupational distribution, pain perception and other factors that are associated with the onset and prognosis of neck pain. In low-income countries, the impact may be particularly devastating. A study in Nigeria found that those with chronic spinal pain were more likely to have mood and substance-abuse disorders and activity limitations [64].

Neck pain also has major economic consequences through the cost of health-care, work absenteeism, insurance, and pressure on health-care systems. A study in the Netherlands found that neck pain cost \$US686 million in 1996. Analysis revealed that direct costs, such as health-care, amounted to just 23% of this figure while indirect costs, such as work absenteeism and disability, amounted to 77% of the total costs [65].

Conclusions

Neck pain is a common problem, which most people experience at some point in their life. Most cases appear to run a chronic-episodic course. The Global Burden of Disease 2005 Study is currently making estimates of the global burden of neck pain in relation to impairment and activity limitation. Results will be available in 2011. Utilisation of a standardised case definition for neck pain in future epidemiological studies will improve between-study comparisons and use of data. Further research is needed to help us understand more about the long-term course of neck pain and its broader outcomes and impacts.

Acknowledgements

We would like to thank the Bill and Melinda Gates Foundation (DH) and the National Health and Medical Research Council (DH, RB) for their financial support. Thank you to Professor Lyn March and Professor Anthony Woolf for their leadership on the GBD 2005 Musculoskeletal Group, and Professor Peter Brooks and Dr Fiona Blyth for their excellent input. Thank you to Professor Theo Vos for his technical support on the GBD 2005 Study. We are also very grateful for the cooperation of the following individuals who provided us data on request: Professor Fereydoun Davatchi; Dr Arash Tehrani; Associate Professor Stefan Ma; Professor Timothy Carey; Dr Jane Darter, Associate Professor Joanne Garrett, Dr Rowsan Ara; Professor Atiqul Haq, and Ms Zeinab Slim.

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