

# A Review of the Social, Psychological, and Economic Burdens Experienced by People with Spina Bifida and Their Caregivers

Diana Rofail · Laura Maguire · Marion Kissner · Antje Colligs · Linda Abetz-Webb

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## ABSTRACT

**Introduction:** Despite measures to reduce the incidence of neural tube defects (NTDs), the rate of decline has not been as dramatic as expected. At least 300,000 newborns worldwide are known to be affected by NTDs each year. This comprehensive literature review summarizes the human and economic burden of NTDs to patients and caregivers, with particular focus on spina bifida (SB).

**Methods:** PubMed, PsycINFO, and Embase were searched for studies from January 1976 to November 2010 that included clinical terms, such as NTD, and at least one patient-reported

outcome or cost term. A conceptual model was also developed.

**Results:** Areas of peoples' lives affected by SB included physical and role functioning, activities of daily living, bodily pain, vitality, emotional functioning, mental health, self-esteem, self-image, social functioning, relationships, and sexual functioning. Areas of caregivers' lives affected included activities of daily living, work impact, time consumption, parental responsibilities (including responsibilities to other children), confidence, feelings and emotions, mental health, stress, social impact, psychological adjustment, relationships (with SB child, siblings, other family members), social support, coping strategies, and termination decisions. Cost burdens on patients and caregivers also include out-of-pocket costs, lost wages, or household production due to increased morbidity and mortality, transportation and other nonmedical costs.

**Conclusions:** This review highlights the need to provide care and support to individuals with SB and their caregivers. Results also emphasize the importance of effective long-term public health campaigns and/or newer strategies to prevent NTDs, such as SB.

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D. Rofail · L. Maguire · L. Abetz-Webb (✉)  
Adelphi Values Ltd, Grimshaw Lane, Bollington,  
Cheshire SK10 5JB, UK  
e-mail: [linda.abetz-webb@adelphivalues.com](mailto:linda.abetz-webb@adelphivalues.com)

M. Kissner · A. Colligs  
Bayer Healthcare, Müllerstr. 178,  
13353 Berlin, Germany



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**Keywords:** Caregivers; Developmental disorders; Economic burden; Human burden; Neural tube defects; Patients; Quality of life; Spina bifida

## INTRODUCTION

After cardiac abnormalities, neural tube defects (NTDs) are the second most common group of serious congenital anomalies [1–3]. NTDs include spina bifida (SB) and anencephaly, as well as cephalocele (or encephalocele), where the brain protrudes through a defect in the skull [4].

Each year, approximately 300,000 newborns worldwide are born with SB or anencephaly [5, 6]. Although prevalence rates of anencephaly and SB are similar, anencephaly results in more abortions because it is more easily detected in prenatal exams, and the condition is fatal to the child [4]. Cephaloceles are less common than anencephaly or SB, occurring in one to three per 10,000 live births [7].

NTDs typically occur when the neural tube fails to close properly, around day 28 following conception [4, 8–10]. Thus, closure of the neural tube often happens before a woman knows she is pregnant [4, 9, 11].

NTD formation has multiple etiologies. Some cases are influenced by genetic components. However, there are potentially preventable cases as well. Decreased NTD risk has been associated with increased folate consumption [12]. Folate is a water-soluble B vitamin that is found naturally in foods, such as fruits, dark green vegetables, potatoes, beans, and yeast extract. Folic acid is the synthetic form of folate found in dietary supplements and added to enriched flour and grain products, such as breads, pasta, rice, and cereals [13–15]. When taken before conception, adequate use of folic acid reduces the incidence of NTDs [16].

In light of this, the US Department of Health and Human Services (HHS) included two “healthy people objectives” for 2010 related to NTDs, to reduce the number of NTDs and to ensure that women have appropriate folate levels prior to conception [17]. Also, public health bodies worldwide, such as The Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO), recommend a daily folic acid intake of 0.4 mg [18–20] taken at least 1 month before pregnancy and in the first trimester of pregnancy [5] to reduce the risk of NTDs (since folic acid only appears in plasma in subjects receiving doses above 0.2 mg). There are three public health strategies for reaching the recommended daily dose: (1) folic acid supplements combined with a healthy diet; (2) voluntary fortification of food with synthetic folic acid; and (3) mandatory fortification of a staple food [21].

In addition, various public campaigns educating both healthcare professionals and the general public have increased international awareness and helped prevent NTDs [21]. However, whilst studies generally demonstrate increased awareness, knowledge, and consumption of folic acid post campaigns [22], the long-term effects of these campaigns are unknown and campaigns are limited to a particular time for a cross-section of their target audience (from as little as 2 days [23] up to 6 years [22, 24]). Therefore, the key audience, women of child-bearing age, may not be reached.

In the US, however, an innovative approach to increasing folate levels can now be achieved through the simple use of combined oral contraceptives (COCs). In 2010, two new COCs known as Beyaz<sup>®</sup> and Safyral<sup>®</sup> (Bayer Healthcare Pharmaceuticals, Leverkusen, Germany) approved by the US Food and Drug Administration (FDA) were launched. Beside a label for contraception, these two COCs are

indicated to raise folate levels for the purpose of reducing the risk of a neural tube defect in a pregnancy conceived while taking the product or shortly after discontinuing the product in women who choose an oral contraceptive as their method of contraception.

The combination of health education programs, recommendations, and food fortification programs has contributed to declines in NTD rates (declines of 26–70% over a period of 15 years). In addition, the reduction might in part be attributable to secondary prevention, as the number of terminations due to improved early diagnosis is rising.

However, the rate of decline has not been as dramatic as expected [25–29] and despite measures to reduce NTDs, approximately 4,500 pregnancies every year in Europe result in a live birth, stillbirth, or termination where a baby or fetus has been affected by an NTD [29], and in the US there are 2,500 live births of children with NTDs each year [30].

Parents (often the sole caregivers) face great distress at the diagnosis of an NTD. They are confronted with either the grief of a termination or stillbirth, or the lifelong emotional and financial challenges of caring for a child with an NTD [31]. Individuals with NTDs that survive, such as those with SB, are often at risk of psychosocial maladjustment and have acute, life-long disabilities [32, 33]. The diverse symptoms can be associated with NTDs adversely impact quality of life (QoL), which can manifest in extensive physical and psychosocial burden [34–42]. There is also associated economic burden incurred, including substantial direct medical treatment costs, direct nonmedical costs (such as special education and developmental costs), as well as indirect costs related to increased morbidity and mortality of patients with NTDs [43].

Health policy makers worldwide increasingly require insight from caregivers' and patients'

perspectives, in addition to information about direct and indirect costs, to demonstrate the overall impact of a condition [44, 45]. This paper reviews the human and economic burden of NTDs on patients and caregivers.

## MATERIALS AND METHODS

### Search Strategy for Literature Search

Although this review was intended to demonstrate the impact of all types of NTDs, since anencephaly is inevitably fatal, the authors' main focus was on the impact of SB on patients and caregivers. Using guidelines defined by the University of York National Health Service (NHS) Centre for Reviews and Dissemination [46], a comprehensive search strategy was developed. The search strategy was implemented using three electronic databases (PubMed, PsycINFO, and Embase) to identify relevant studies from January 1976 to November 2010. The following clinical terms were used: "neural tube defects," "NTDs," "spina bifida," "anencephaly," and "meningocele." Patient-reported outcome (PRO) terms included "Health-Related Quality of Life," "HRQoL," "quality of life," "QoL symptoms," "satisfaction," "body image," "self-image," "emotional," "physical," "psychological," "psychosocial," "self-esteem," "impact," "relationships," "caregiver burden," "family impact," "work," "productivity," "absenteeism," "presenteeism," "qualitative," "interviews," "grounded theory," and "interpretive phenomenological analysis." Cost terms included "cost," "economic," "burden/impact of illness," "resource use," "hospitalization," and "economic evaluation." "Family planning," "unplanned pregnancy," "prenatal care," "abortion," and "termination" were other keywords used.

## Conference Proceeding Abstract Searches and Internet Searches

In addition to the electronic database searches, abstracts from the International Federation for SB and Hydrocephalus 17th International Conference were hand-searched to capture recent information that may have been presented but not yet published in journals. Internet searches of family caregiver associations and societies were also conducted to access information from grey literature; these included The Association for SB and Hydrocephalus (UK), The SB Association (US), The Scottish SB Association (UK), and SB Family Support (US).

## Inclusion and Exclusion Criteria

Following completion of the search, all titles and abstracts were screened for possible inclusion in the study by two independent researchers (DR and LM). To satisfy the inclusion criteria, selected abstracts included an appropriate clinical term and at least one of the PRO terms or cost terms. The review pool was restricted to English language studies, human subjects, and articles published from January 1976 to November 2010. All letters and foreign language studies were excluded. The selected studies contained keywords in the title or abstract. Studies were excluded only if the reviewers could be sure that they did not fulfill the criteria.

## Ranking Process

Due to the high number of seemingly relevant articles, following the inclusion/exclusion criteria, abstracts were ranked 1, 2, or 3, according to the following three criteria: (1) the journal article included terms of interest in

the title and abstract and the terms of interest were the main focus; (2) the journal article included the terms of interest as secondary or exploratory analyses; or (3) the abstract contained supportive information, but there was no real data (e.g., there was a background comment in the introduction or conclusions). Following the ranking process, articles ranked 1 were included and all others were excluded from this review.

## Currency Conversion

To facilitate comparison of economic studies, costs were inflated to 2010 US dollar prices using the Consumer Price Index inflation calculator (available at [www.bls.gov/data/inflation\\_calculator.htm](http://www.bls.gov/data/inflation_calculator.htm)) (original costs are reported in brackets) [47].

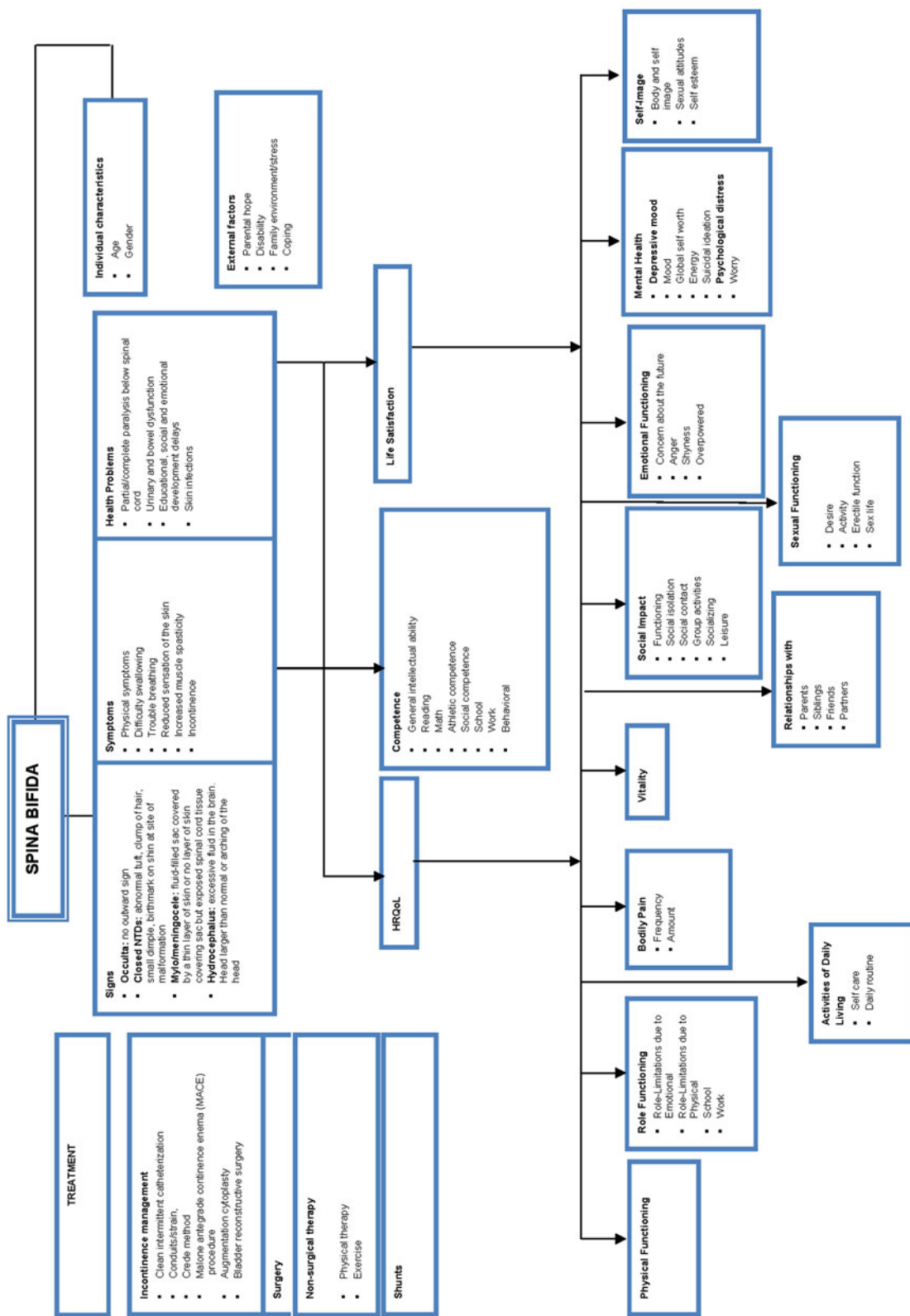
## RESULTS

### Study Selection

The initial literature search resulted in a pool of 4,456 abstracts. The titles and abstracts were then examined in further detail and a total of 4,288 were excluded for not containing all of the search terms in the title or abstract following ranking, or due to duplication between the databases. Thus, a total of 166 articles were reviewed in detail. The majority of these papers were US focused.

### Impact of SB on Individuals

The impact of SB from the patient's perspective has been extensively documented [34, 37–39, 48–70]. Using information from the articles included in this review, a conceptual model was developed to demonstrate the relationship between various factors associated with SB in



**Fig. 1** Impact of spina bifida on patients. *HRQoL* health-related quality of life, *NTDs* neural tube defects

individuals (Fig. 1). A conceptual model compartmentalizes potential causes, consequences, and signs and symptoms of the disease while showing how they are linked with one another.

Areas of patients' lives affected include physical functioning, activities of daily living, role functioning, bodily pain, vitality, emotional functioning, mental health, self-esteem, self-image, social functioning, relationships, and sexual functioning (see Fig. 1). Long-term health problems of SB include urinary tract infections, calculi (kidney stones), and skin infections. Children with SB also do not grow and develop at a normal rate [4].

Grimby looked at the differences between two groups of subjects: one with cerebral palsy, the other with SB, in their dependence and their perceived difficulty in performing daily activities. Subjects in both groups needed help in basic activities of daily living; however, SB subjects were more impacted by toileting problems and lack of bladder and bowel control than the cerebral palsy subjects. SB patients also had more mobility problems related to instrumental daily tasks [71].

### Impact on Caregivers

The impact of SB on caregivers has also been well documented [2, 38, 40, 43, 72–92]. Parents face great distress upon diagnosis of an NTD in their child. They are confronted with either the grief of a termination or stillbirth, or extensive emotional and financial challenges of caring for a child with an NTD. Caring for patients with SB who may have comorbidities can also exert a substantial burden on caregivers, including the impact on carer workload, decreased QoL, less time for work, and additional responsibilities [93]. Areas of caregivers' lives affected include activities of daily living, work impact, time

consumption (including the need to always be on hand to provide the level of care required for individuals with SB) [74, 76, 80], parental responsibilities (including responsibilities to other children), confidence, feelings and emotions, mental health, stress, social impact, psychological adjustment, relationships (with SB child, siblings, and other members of the family), social support, coping strategies, and termination decisions. In one study on caregivers of children with cerebral palsy or SB, caring for an affected child took up to 29% of their waking time [81]. This equated to more time than spent cooking, cleaning, and doing the laundry (26%). Leisure activities and work took up the least amount of their time [81, 94].

### Economic Impact of NTDs on Individuals and Caregivers

The average lifetime direct medical cost per person with SB ranges from \$285,959 (\$235,839 in 2002 dollars) [95] to \$378,000 (\$319,000 in 2003 dollars) [96] in 2010 dollars. This does not include lifetime direct nonmedical costs (such as special education and development services) of \$52,570 per person (\$43,371 in 2002 dollars) [95]. A significantly greater economic impact is related to "indirect" costs due to increased morbidity and premature mortality in individuals with an NTD. The average lifetime indirect cost per person with SB in the US was estimated to be \$432,176 (\$356,553 in 2002 dollars) in 2010 dollars, or 57% of the average total lifetime cost per person with SB [95].

The cost burden on individuals and caregivers includes out-of-pocket costs, lost wages/household production due to increased morbidity and mortality, transportation, and other nonmedical costs. Very few studies examine the costs of NTDs from the perspective of patients and/or caregivers.

Ouyang et al. reported the out-of-pocket cost burden to privately insured patients in the US. According to this study, individuals with SB in a private health insurance plan shared on average 11% of their total health expenditure (8% of costs for their inpatient care, 11% of costs for outpatient visits, and 17% of costs for prescription drugs), which in 2006 was \$40,928 (\$34,536 in 2003 dollars) per person (taken as an average across all age groups of people with SB) [96].

Despite the potential important contribution of caregiver time costs to the total cost estimate of birth defects, only three studies estimated caregiver time costs related specifically to birth defects [97–99]. Average reductions of 14 h per week in paid work time for mothers and 5 h per week for fathers of children with SB were reported [99]. Differences in work hours by caregivers of children with SB translated into lifetime costs of \$162,124 in 2010 dollars (\$133,755 in 2002 dollars) using a 3% discount rate, and an age- and sex-adjusted earnings profile [99].

## DISCUSSION

The results from this review demonstrated the profound impact of SB on individuals and caregivers. For patients, this lifetime impact is apparent in physical, emotional, mental, educational, sexual, social, and financial aspects of everyday life. The conceptual model developed based on the literature highlights the notable range and variety of the impact on patients with SB. For caregivers, the emotional and financial burden along with the toll on their social lives and work were the greatest impacts. Caregivers also experience additional financial burden, including reduced income due to the necessity of working a reduced number of hours in paid employment. Patients and

caregivers also incur substantial direct treatment costs for NTD.

The diverse humanistic impact and economic burden of SB for individuals and caregivers emphasizes the importance of providing substantial care and support to both. In addition, as outlined earlier, sustained and persistent education about the benefits of preconceptional folates is important to help prevent NTDs, especially since the burden is so often avoidable with adequate folate consumption at the right time [21]. However, whilst long-term, effective health campaigns educating the public about the benefits of preconceptional folate may help reduce NTD risk, given the limitations of such campaigns, additional strategies, such as different types of targeted fortification, may be warranted to reduce this risk even further.

Some limitations of this review deserve comment. It is important to acknowledge that this literature review and its findings are based on published English literature studies that emerged from searching electronic databases. Studies were qualitatively discussed, and there was insufficient data to synthesize the evidence. Further research could use statistical methods to explore the net effect of NTDs and treatment.

Furthermore, the majority of the papers in this review were US focused, especially economic-related papers. Little is known about the cost that SB has on individuals' health-related QoL in Europe and other regions outside of the US. Therefore, there is a need for additional studies in Europe and Asia, and future studies could be designed to address this.

In addition, while SB is a major type of NTDs, other rarer forms of NTDs also exist. Although there is a significant body of evidence to demonstrate the impact of SB on individuals and caregivers, this comprehensive literature review may under-represent the impact of anencephaly on prospective parents and rarer

types of NTDs, which are also likely to have a profound effect on individuals and caregivers.

## CONCLUSION

Given the substantial range and variety of humanistic impact and economic burden of SB, this review highlights the need to provide care and support to individuals with SB and their caregivers. Results also emphasize the importance of effective long-term public health campaigns and/or newer strategies to prevent NTDs, such as SB.

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**Conflict of interest.** M. Kissner is employed by Bayer Healthcare. A. Collings is employed by Bayer Healthcare. D. Rofail was employed by Adelphi Values at the time this manuscript was written. L. Maguire is employed by Adelphi Values. L. Abetz-Webb is employed by Adelphi Values. Adelphi Values have been contracted by Bayer to conduct this research.

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