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Cost-effectiveness of acupuncture treatment in patients with chronic neck pain

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Abstract

Acupuncture is increasingly used in patients with chronic pain, but there is a lack of evidence on the cost–benefit relationship of this treatment strategy. The objective of this study was to assess costs and cost-effectiveness of additional acupuncture treatment in patients with chronic neck pain compared to patients receiving routine care alone. A randomized controlled trial including patients ($\geqslant$18 years of age) with chronic neck pain (>6 months) was carried out. We assessed the resource use and health related quality of life (SF-36) at baseline and after 3 months using complete social health insurance funds and standardized questionnaires, respectively. The main outcome parameters were direct and indirect cost differences during the 3 months study period and the incremental cost-effectiveness ratio (ICER) of acupuncture treatment. A total of 3,451 patients (1,753 acupuncture-group, 1,698 control-group) were randomized (31% men, age 53.5 ± 12.9 years; 69% women, 49.2 ± 12.7 years). Acupuncture treatment was associated with significantly higher costs over the 3 months study duration compared to routine care (€925.53 ± 1,551.06 vs. €648.06 ± 1,459.13; mean difference: €277.47 [95% CI: €175.71–€379.23]). This cost increase was mainly due to costs of acupuncture (€361.76 ± 90.16). The ICER was €12,469 per QALY gained and proved robust in additional sensitivity analyses. Since health insurance databases were used, private medical expenses such as over the counter medication were not included. Beyond the 3 months study duration, acupuncture might be associated with further health economic effects. According to international cost-effectiveness threshold values, acupuncture is a cost-effective treatment strategy in patients with chronic neck pain.

Keywords: Cost-effectiveness analysis; Net health benefit; Acupuncture; Routine care; Economic evaluation; Chronic neck pain

1. Introduction

Chronic neck pain is a common complaint in the general population and can result in substantial medical consumption, absenteeism from work and disability (Borghouts et al., 1999). According to recent surveys, the number of patients with chronic pain who use complementary and alternative medicine is growing (Eisenberg et al., 1998; Thomas et al., 2001; Härtel and Volger, 2004). In particular, acupuncture is increasingly used in the treatment for chronic neck and back pain (Eisenberg et al., 1998).

In Germany acupuncture is mainly administered by physicians. The treatment is a relatively resource-intensive intervention due to the time involved for physicians and patients alike (Paterson and Britten, 2004). To date, there is a lack of information on costs and cost–benefit relationship of acupuncture compared to routine care treatment.

Therefore, the objective of the present study was to investigate the costs and cost-effectiveness of acupuncture in addition to routine care in patients with chronic

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low neck pain compared to routine care alone. This manuscript will focus on the health economic analyses.

2. Methods

2.1. Study design

In a multi-center randomized controlled trial, patients ($\geqslant$18 years of age) with a clinical diagnosis of chronic neck pain (>6 months duration) were enrolled after contacting the participating physician. The patients were allocated to an acupuncture group that received immediate acupuncture treatment or to a control group that received delayed acupuncture treatment after 3 months. Both groups were free to use conventional routine medical care as offered by the German social health insurance funds.

Participating physicians were required to have received at least 140 h of acupuncture training. This education and further education include wide variations in style and training of acupuncture. The acupuncture treatments consisted of 10–15 acupuncture sessions. The primary outcome measure was neck pain and disability as assessed by the validated neck pain and disability scale (NPAD) developed by Wheeler et al. (1999). Secondary outcome parameters included the quality of life measured by the SF-36 (Bullinger and Kirchberger, 1998) questionnaire. The patients completed standardized questionnaires at baseline and after 3 months.

2.2. Costs

Costs considered were direct health care such as costs of acupuncture, physicians' visits, hospital stays (without consideration of private individual billing) as well as prescription drugs (including patient's co-payment). The payment for each acupuncture session was €35. The cost perspective of the study was societal. Therefore, in addition to health insurance costs we also regarded indirect costs caused by patients work incapacity. These indirect costs were determined by using the human capital approach (Hanoverian Consensus-Group, 1994) and were estimated to be about €78 per day sick from work. The resource use was obtained by using statutory health insurance databases.

We calculated (1) the overall costs during the study period of 3 months after randomization including costs not related to chronic low back pain and (2) diagnosis-specific costs using ICD-10 Codes to identify costs due to only chronic low back pain and related conditions.

2.3. Economic analyses

In the case of higher costs and better medical outcome, additional cost-effectiveness analyses were performed. The SF-36 values were transformed into the SF-6D using the algorithm developed by Brazier et al. (2002). Only patients with complete SF-36 data were included in the cost-effectiveness analysis. Quality adjusted life years gained were calculated by adopting the area under the curve method (Thompson and Barber, 2000; Richardson and Manca, 2004) using the following formula:

$$\mathrm{QALYutility}_{\mathrm{gained}} = \left(\frac{\alpha_{\mathrm{Acupuncture}} + \beta_{\mathrm{Acupuncture}}}{2}\right) - \left(\frac{\alpha_{\mathrm{Control}} + \beta_{\mathrm{Control}}}{2}\right)$$

The analysis is based on the utility values at each time point (α = baseline utility, β = utility after 3 months) and uses the common assumption of a linear change over time (Richardson and Manca, 2004). As the health economic section of our study was designed to focus on estimation rather than on hypothesis testing, we calculated the incremental cost-effectiveness ratio (ICER), by using the following relation (Claxton, 1999):

$$\mathrm{ICER} = \frac{\text{mean costs}_{\mathrm{Acupuncture}} - \text{mean costs}_{\mathrm{Control}}}{\text{mean QALY}_{\mathrm{Acupuncture}} - \text{mean QALY}_{\mathrm{Control}}}$$

The net benefit approach (Zethraeus et al., 2003) was used to measure the incremental cost-effectiveness against a societal threshold value λ, that is often described as society's willingness to pay for one extra QALY (quality adjusted life years) gained. Bootstrapped cost-effectiveness results were transformed into net benefit values under varying threshold values and then plotted in a cost-effectiveness acceptability curve. Under a Bayesian framework, the cost-effectiveness acceptability curve shows the probability that the incremental cost effectiveness is below λ, for a whole range of values of λ (Lothgren and Zethraeus, 2000). For a given value of λ, an intervention would be considered cost-effective if its net benefit is greater than zero or in other words, the ICER lies below λ. Thus, a new treatment should replace the existing one when the net benefit under λ is greater than zero (Lothgren and Zethraeus, 2000).

In the UK, a threshold of 30,000 £/QALY is found to be consistent with decisions of adopting new technologies by NICE (Raftery, 2001). In Germany, such a threshold does not yet exist, so we used an arbitrary and hypothetical threshold of max. €50,000 per QALY.

2.4. Sensitivity analyses

Additional sensitivity analyses were performed varying duration of therapeutic and economic effects. The observed outcome differences between both treatment groups were assumed to gradually decrease over time. The total duration of this decrease was varied from 6 months up to 4 years. Furthermore, the costs of acupuncture were varied in different scenarios from €15 up to €55 per acupuncture session.

For sensitivity analyses, the study situation was always defined as base-case. In base-case scenario there was no need to discount any costs or effects, because of the observation period less than 1 year. Discounting is a widely used method in health economic research. It is the process of finding the current value of future costs and savings (alternatively future medical impairments or benefits). For example, possible cost savings of €1,000 in future years are considered less valuable compared to savings of €1,000 at present (e.g. due to monetary inflation or individual time preference). Using a discount rate of 3% in future cost reduction of €1,000 would be associated with a current value of €970. In the present analyses we discounted future QALY effects (beyond 1 year) at 1.5% and costs at 3% with additional sensitivity analyses for QALY effects from 0% to 10% and for costs from 0% to 5%. The discount

rates used in the present study are compatible with those published previously (Coyle and Tolley, 1992; Wonderling et al., 2004).

2.5. Statistical analyses

The means for unadjusted costs of the two groups were compared using Wilcoxon–Mann–Whitney test. For derivation of cost-effectiveness acceptability curves non-parametric bootstrapping was used. Therefore, the original sample was bootstrapped 1,000 times in order to obtain 1,000 means for costs and effect differences as well as the resulting ICERs. For inferential statistics, SPSS© version 11.0 was used, for creation of cost-effectiveness acceptability curves we used MS EXCEL© 2000.

3. Results

3.1. Baseline characteristics

A total of 3,451 patients (1,753 Acupuncture; 1,698 Control) with chronic neck pain were enrolled after initial contact with the participating physicians. For all patients sociodemographic and economic data were available. At baseline there were no significant differences between both treatment groups except for a somewhat older age of control patients (Table 1). Complete quality of life-data (SF-36) were available for 3,005 (87%) patients (1,550 Acupuncture; 1,455 Control).

3.2. Cost-analyses

The participating patients received a mean number of 10.3 ± 2.6 acupuncture sessions over the 3 months study duration. Table 2 shows the mean costs during the 3 months study period as well as the cost differences between baseline (3 months period before study entry) and the 3 months period after study entry. The mean overall costs of acupuncture patients during the study period were €$925.52 \pm 1{,}564.76$ (diagnosis specific: €441.87 ± 546.81) compared to €$648.06 \pm 1{,}496.13$ (diagnosis specific: €115.79 ± 738.85) in control patients ($p < 0.001$). We observed significant differences in medication related costs in favor of acupuncture ($p = 0.001$). In diagnosis-specific analysis, the acupuncture patients caused significantly lower total costs without consideration of acupuncture costs (€80.11 ± 538.20 vs. €115.79 ± 85; $p = 0.049$). The mean cost difference between both treatment groups 3 months after study entry (total overall: €277.47, 95% CI €175.71–379.23; diagnosis-specific €326.16, 95% CI €282.99–369.35) was essentially due to the acupuncture costs in the acupuncture group (€361.76 ± 90.16).

In acupuncture patients, the overall cost difference between baseline and study-end was €$347.47 \pm 1{,}672.39$ compared to €$28.91 \pm 1{,}255.58$ in control patients ($p < 0.001$). Similarly the diagnosis-specific difference was €354.52 ± 413.77 in acupuncture patients compared to €6.58 ± 466.95 in control patients ($p < 0.001$). By analyzing costs excluding acupuncture, there were no significant overall cost differences between both study groups. Also in individual cost components no significant differences were observed, except in diagnosis-specific medication costs.

3.3. Cost-effectiveness-analyses

In the acupuncture group 0.024 ± 0.004 additional QALYs were gained compared to the control group (Table 3) associated with additional costs (overall: €293.91 ± 51.79; diagnosis-specific: €321.02 ± 24.38). The (ICER) was €12,469 (overall) and €13,618 (diagnosis-specific) per QALY gained. Therefore, for the assumed threshold value of €50,000 the additional acupuncture intervention was cost-effective. Fig. 1 shows

Table 1
Baseline characteristics of study population

Parameters	Acupuncture ($n = 1{,}753$)	Control ($n = 1{,}698$)	p
	Mean ± SD/n (%)	Mean ± SD/n (%)	
Female	69.9	67.9	0.211
Age (years)	49.8 ± 12.8	51.4 ± 13.0	<0.001
>10 years of school	31.4	30.1	0.381
Duration of disease (years)	6.0 ± 6.9	6.1 ± 7.3	0.686
Neck pain and disability[a]	55.0 ± 15.8	53.9 ± 16.0	0.056
SF-36 Physical Component Score	37.6 ± 8.4	38.1 ± 9.1	0.129
SF-36 Mental Component Score	43.1 ± 12.1	43.8 ± 12.1	0.097
Cost categories (*during 3 months before study onset*)			
Physician visits	46.83 ± 110.25	49.49 ± 123.03	0.734
Medication	94.28 ± 164.93	107.92 ± 205.72	0.091
Hospital stays	111.74 ± 1,009.53	101.11 ± 609.04	0.820
Indirect costs	325.22 ± 1,100.42	360.18 ± 1,206.59	0.573
Total overall costs	578.07 ± 1,589.23	619.15 ± 1,468.82	0.128

[a] Lower values indicate less pain.

Table 2
Mean costs (during 3 months after study entry) and differences (3 months before study entry vs. costs 3 months after study entry) in €/patient

Different cost components	Acupuncture ($n = 1,753$) Control ($n = 1,698$) 3 months after study onset		p	Acupuncture ($n = 1,753$) Control ($n = 1,698$) Mean cost-difference 3 months before vs. 3 months after study onset		p
	Mean ± SD	Mean ± SD		Mean ± SD	Mean ± SD	
Overall costs						
• Acupuncture	361.76 ± 90.16	–	–	361.76 ± 90.16	–	–
• Physician visits	77.92 ± 136.14	78.96 ± 160.08	0.836	31.09 ± 145.28	29.02 ± 173.52	0.704
• Medication	93.96 ± 170.99	112.02 ± 188.72	0.001	−0.32 ± 114.09	4.10 ± 126.29	0.281
• Hospital stays	86.33 ± 881.30	90.68 ± 552.75	0.222	−25.42 ± 1,340.68	−10.43 ± 809.27	0.692
• Indirect costs	305.57 ± 1,114.43	366.40 ± 1,251.79	0.465	−19.65 ± 798.39	6.22 ± 797.27	0.341
Total overall costs	925.52 ± 1,564.76	648.06 ± 1,496.13	<0.001	347.47 ± 1,672.39	28.91 ± 1,255.58	<0.001
Overall costs without acupuncture-costs	563.77 ± 1,549.96	648.06 ± 1,496.13	0.063	−14.29 ± 1,672.13	28.91 ± 1,255.58	0.392
Diagnosis-specific costs						
• Acupuncture	361.76 ± 90.16	–	–	361.76 ± 90.16	–	–
• Physician visits	13.42 ± 53.46	13.14 ± 57.34	0.306	5.15 ± 51.71	3.61 ± 60.37	0.422
• Medication	5.57 ± 27.69	10.36 ± 55.14	0.003	−1.49 ± 22.08	0.79 ± 28.84	0.009
• Hospital stays	0 ± 0	5.33 ± 193.75	0.150	−2.74 ± 70.27	−2.11 ± 281.10	0.927
• Indirect costs	61.12 ± 530.54	86.96 ± 656.37	0.505	−8.17 ± 392.40	4.28 ± 355.77	0.329
Total diagnosis-specific costs	441.87 ± 546.81	115.79 ± 738.85	<0.001	354.52 ± 413.77	6.58 ± 466.95	<0.001
Diagnosis-specific costs without acupuncture-costs	80.11 ± 538.20	115.79 ± 738.85	0.049	−7.24 ± 404.31	6.58 ± 466.95	0.353

Table 3
Mean costs (overall and diagnosis-specific) and QALYs of Acupuncture patients and Control patients after 3 months study duration

	Acupuncture $n = 1,550$ (mean ± SD)	Control $n = 1,455$ (mean ± SD)	Difference ACU vs. CON (mean ± SE)	p-values
Overall costs	€919.07 ± 1,368.31	€625.16 ± 1,470.69	€293.91 ± 51.79	<0.001
Diagnosis-specific costs	€443.69 ± 532.64	€122.67 ± 786.65	€321.02 ± 24.38	<0.001
QALYs	0.649 ± 0.096	0.625 ± 0.103	0.024 ± 0.004	<0.001

the cost-effectiveness-plane for the overall costs as well as for the diagnosis-specific cost perspective. The ICERs are located in the upper right-hand quadrant of the cost-effectiveness-plane showing that acupuncture in routine care is both, more effective and more costly than routine care alone. The net benefit of acupuncture is about €911 (€333 to €1,449) for the overall cost perspective and €900 (€282 to €1,444) for diagnosis-specific perspective. The probability that this intervention is cost-effective is approximating 100% for the threshold value of €50,000 (Fig. 2).

3.4. Sensitivity analyses

The modeled treatment effect duration up to 4 years and the calculated changes in probability of cost-effectiveness are shown in Fig. 2. The probability of 100% was reached at threshold values of €5,400 for the assumed 4 years effect duration. The modeled 6 month effect duration reached a 99.5% probability of cost-effectiveness at the €50,000 threshold value. Discounting the monetary costs and benefits up to 5% as well as varying the discount rates for effects between 0% and 10% (following a recommendation of Coyle and Tolley, 1992) did not change the major findings of our study.

Varying the acupuncture session payment rates the probability of 100% cost-effectiveness range between threshold values of €7,800 for €15 and €42,900 for €55 per acupuncture session.

4. Discussion

Acupuncture in addition to routine care compared with routine care alone was associated with better quality of life as well as higher costs. This increase of costs was essentially due to acupuncture costs and was not compensated for by relevant savings in other health care components during the study period. The ICER was between €12,469 (overall) per QALY gained and €13,618 (diagnosis-specific) per QALY gained. When adopting a threshold of €50,000 per QALY gained, acupuncture in addition to routine care is, therefore, cost-effective.

To our knowledge, this is the first cost-effectiveness analysis for acupuncture treatment in patients with chronic neck pain. The large sample size allows for a

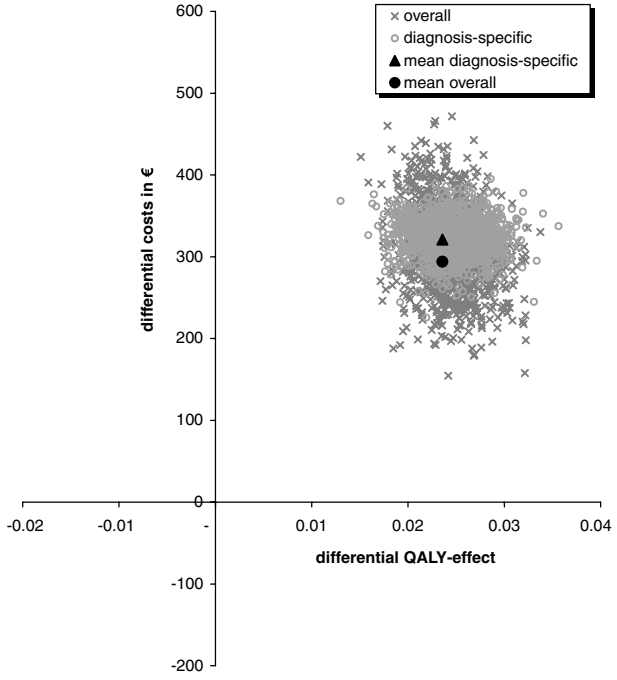

Fig. 1. Cost-effectiveness-plane (bootstrapped cost-effectiveness-ratios).

robust estimation of costs. A possible limitation is the fact that the only source of costs consisted of the social health insurance funds databases. Thus, private expenses such as over the counter medication could not be included. By using the social health insurance funds databases, all patient contacts with the German health care system were captured apart from the purely "private" ones paid for only by the patients. Patients insured by one of the approx. 300 social health insurance funds in Germany (approx. 87.8% of the population (Federal statistical department Germany, 2004)) have free choice of physicians and their visits are (almost without exception) covered by the social health insurance funds. Thus, costs for private visits to physicians were considered to be negligible.

The assessment of QALYs in clearly defined disorders is more precise than for diseases with a less specific pattern of symptoms. It is possible that our results do not reflect real-life cost-effectiveness, but the used algorithm of Brazier tends to generate relatively higher ICERs compared to other approaches (Pickard et al., 2005). Therefore, our analysis is based on a conservative appraisal method.

Another limitation arises from the duration of the study. The cost and effectiveness data were compared between the two groups for 3 months after baseline since subsequently patients in the waiting list control group were also offered acupuncture. Therefore, possible long-term health economic effects could not be investigated in the present study. For this, it would be necessary to conduct further long-term investigations using a different study-design.

The projection of the 3 months therapy effect in our base-case-scenario up to 1 year was supported by findings of other longer-term acupuncture trials (Brinkhaus et al., 2003; Thomas et al., 2005; Witt et al., 2005; Brinkhaus et al., 2006). These studies were carried out using a similar study design like number of treatment sessions or treatment duration, compared to the present study but included longer-term outcome assessment. The cost-effectiveness of acupuncture clearly depends on the length of effects since maintaining short-term effects (or in case of steep drops off in effects) would require repeat acupuncture sessions at increased overall costs resulting in a decreased cost-effectiveness ratio. Additional sensitivi-

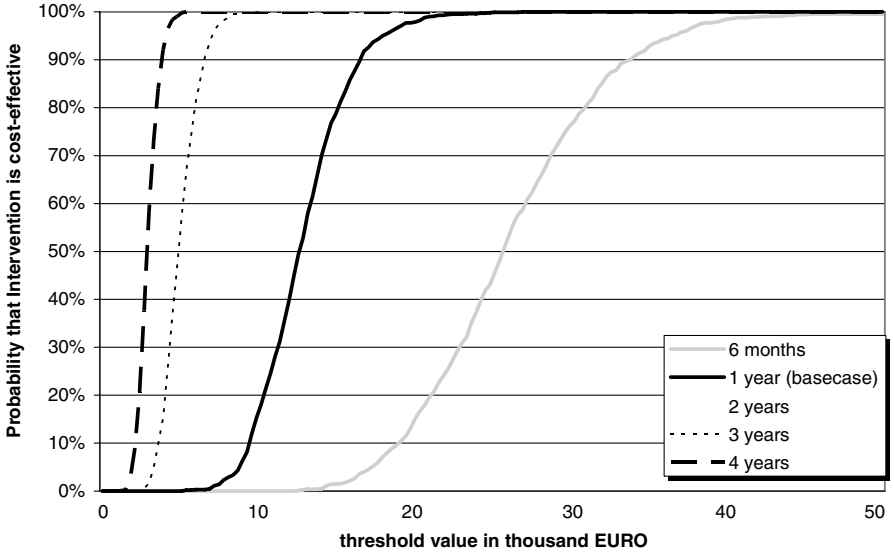

Fig. 2. Cost-effectiveness acceptability curve and sensitivity analyses of effect duration.

ty analyses were performed according to varying assumptions including modeling of effect duration of 6 months up to 4 years and projection of different acupuncture session costs between €15 and €55. One might speculate, however, that a reduction in physicians payment could perhaps result in lower treatment effects, leading to less favorable ICER and a decreased probability of cost-effectiveness. Since at present, acupuncture is not routinely reimbursed by the statutory health insurance companies, costs of the acupuncture session were determined arbitrarily. There are no prices/costs in the German health care system (under the financing of the social health insurance funds), the fees/charges are administratively fixed prices and not necessarily related to the costs induced by the use of general practitioners for the procedure. In the fee used in the base-case (€35 per acupuncture session), costs for needles and other consumables are supposed to be included. The final charge for such an acupuncture treatment would be subject to negotiations between the general practitioners' organizations and the social health insurance funds in the case of inclusion of the treatment in the nationally valid list of health care services.

The present study includes, to our knowledge, the first calculation of ICERs for acupuncture treatment in patients with chronic neck pain. Recently, a rigorous cost-effectiveness analysis on acupuncture for chronic headache in primary care in a UK setting yielded comparable ICERs as the ones reported in this study (Wonderling et al., 2004). A publication of Thomas et al. (2005) assessing the cost effectiveness of acupuncture treatment in patients with low back pain compared to usual care reported an ICER about €6,500 per QALY gained. Further other treatment methods in back pain were assessed by using ICERs. For example, the published ICERs ranges between €5,520 for osteopathy treatment of subacute spinal pain (Williams et al., 2004) and €73,310 for surgical stabilization of patients with chronic low back pain (Rivero-Arias et al., 2005). Acupuncture, therefore, seems to be a comparatively cost-effective treatment strategy in patients with chronic neck pain.

5. Conclusion

In conclusion, our study shows that treating patients with chronic neck pain with acupuncture in addition to routine resulted in a marked clinical relevant benefit and was relatively cost-effective. Acupuncture should be considered a viable option in the medical care of patients with chronic low neck pain.

List of contributions

All authors participated in the planning of the protocol and revision of manuscript drafts. Specific tasks and responsibilities: general trial coordination (C.M.W., S.J., D.S., B.B.), statistical analysis and economical expertise (T.R., D.S., S.J., C.M.W., S.N.W.), overall medical and scientific responsibility (S.N.W.).

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Role of the Funding Source

The trial was initiated due to a request from German health authorities (Federal Committee of Physicians and Health Insurers) and sponsored by German Social Health Insurance Funds. All decisions on design, data collection, analysis, interpretation, and publication were the complete responsibility of the researchers.

Conflict of Interest

All authors: none.

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