



Long-term cost savings with Centering-based group antenatal care

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ABSTRACT

Introduction: Group antenatal care (gANC) is a group-based care-model combining routine antenatal care, with health assessment, education, and community building. GANC has shown positive results on perinatal outcomes. However, midwives in Dutch primary care have reported higher costs when providing gANC. The purpose of this study was to assess the effect of replacing individual prenatal care (IC) by gANC on (expected future) health care costs and health outcomes.

Methods: We performed an exploratory cost-benefit analysis comparing costs and consequences of gANC with those of IC, using a hypothetical cohort of 12,894 women in gANC. Primary input data were derived from a stepped wedge cluster randomized controlled trial carried out in the Netherlands, assessing both health and psychosocial effects of gANC comparing them with IC. Other data was retrieved from available literature and an online questionnaire among midwifery practices. The main outcome measure was differential cost of gANC and lifetime direct healthcare costs related to the effects of gANC compared to IC (price level 2019).

Results: Results showed that gANC comes at a differential cost of €45 extra per person when compared to IC. However, projected healthcare cost-savings related to increased breastfeeding rates, reduced prevalence of pregnancy induced hypertension and less postpartum smoking, lead to an average net cost-savings of €67 per gANC participant.

Discussion: Although gANC shows better health- and psychosocial outcomes when compared to IC, it is more costly to provide. However, findings indicate that the differential costs of gANC are off-set by long-term healthcare cost-savings.

Statement of Significance

Problem: Primary care midwives in the Netherlands report higher costs when providing gANC to low-risk women. Moreover, it is unknown if higher costs are compensated by better (long-term) outcomes of pregnancy.

What is Already Known: gANC provides better short term pregnancy outcomes. Studies in the United States indicate possible cost savings as a result of improved pregnancy outcomes among high risk populations.

What this Paper Adds:

This study shows better health- and psychosocial outcomes for low-risk women receiving gANC and that gANC is more costly to

provide. It indicates that differential costs of gANC are off-set by long-term healthcare cost-savings.

Introduction

The widely accepted traditional biomedical antenatal care model consists of ten to fifteen one-on-one consultations with a midwife or a doctor aimed at medical care, prevention of complications, psychosocial support, and information provision. Consultations are usually limited to time slots of 10–15 min. (WHO, 2022; RCOG, NICE, 2021). In The Netherlands most antenatal care is carried out by midwives working in community-based midwifery practices, consisting of three to six midwives who have a joint workload of 110 births per year per full-time

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working midwife (KNOV, 2022). In response to the relatively high perinatal mortality rate in the Netherlands, changes in maternity care were initiated by a national steering committee installed by the Dutch Ministry of Health. The subsequent report advised more client-oriented care, better information for parents, more proactive support and more attention to vulnerable women and families (Stuurgroep Zwangerschap en geboorte, 2009). In addition, the biomedical model of antenatal care has been criticized in recent years as it no longer answers to the needs of pregnant women (Downe et al., 2018) and dissatisfied consumer groups have been calling for maternity care reform by demanding a more woman-centered approach (Geboortebeweging, 2023). Moreover, the current thinking that the definition of health includes social and mental well-being, is gaining ground (European Commission, 2023; WHO, 2023; Huber et al., 2011). Inefficiency and economic instability in turn, lead to an unequal distribution of health and health care within the population. 'Social Determinants of Health' and the principles of 'Value-Based Healthcare' are increasingly applied to the design of health care in order to increase people's ability to deal with the physical, emotional and social challenges in life and to ensure that the supply and demand of health care are better matched.

Within this climate of change Centering based group antenatal care (gANC) was initiated in the Netherlands in 2011 as an innovative approach to integrated antenatal care to better meet women's needs and improve perinatal outcomes. The model combines the medical assessment with interactive antenatal health education, peer support and community building, facilitated by a specifically trained midwife or doctor and supported by a co-facilitator, within an empowering group environment (Rising, 1998; Rising et al., 2004). Currently approximately a third of all midwifery practices in The Netherlands provide gANC.

gANC has been shown to be effective in improving health outcomes for mother and baby, as well as in improving health care satisfaction (Rijnders et al., 2019; Teate et al., 2011; Ickovic 2007; Cunningham 2019; Jones et al., 2023). However little is currently known about the effects of gANC on health care costs and health outcomes. Few studies in the United States (US) indicate possible cost savings as a result of improved pregnancy outcomes among high risk populations but these outcomes are dependent on specific contexts such as the organization of care (Rowley et al., 2016; Crockett et al., 2017; Gareau et al., 2016). Primary care midwives have reported higher costs when providing gANC, whereas it is unknown if these higher costs are compensated by better outcomes (Loket Gezondleven, 2022). The purpose of this exploratory cost-benefit analysis is to assess the effect of (simulating) replacing regular, individual prenatal care (IC) by gANC, based on a 35% access rate and antenatal health care costs and health outcomes, as well as expected future healthcare costs.

Methods

Study design

In this exploratory cost-benefit analysis the difference in cost between gANC and IC was related to the health effects of gANC compared to those of IC, expressed in costs. The analysis was performed from a health care perspective. We designed a study using the data of the Connect-In study, a stepped-wedge cluster randomised controlled trial set in The Netherlands, to investigate the effect of gANC on pregnancy outcomes combined with data of an online questionnaire to estimate antenatal time investment, of both gANC and IC, by midwives and co-facilitators. Details of the full trial design are reported by Van Zwicht et al. (Van Zwicht et al., 2016). The study was approved by the Central Committee on Research Involving Human Subjects and the Medical Ethics Committee of the Leiden University Medical Center. Written informed consent was obtained from participants at 8 to 12 weeks gestation during their first antenatal visit. This included permission to collect women's pregnancy outcome data as registered in the National

Dutch Perinatal Data Registry and consent to participate in a questionnaire to be filled in at 12, 28, 36 weeks of pregnancy and 6 weeks after pregnancy. The trial included thirteen community midwifery practices and the obstetric departments of two hospitals from three regions in The Netherlands. Every region was randomly assigned to a start date for gANC with a between-step period of three months. Health care providers collected data of pregnant women before (control period) and after they started with gANC (intervention period). During the intervention period one third of the study population chose to participate in gANC, of which 65 % were nulliparous women and 35 % parous women (Wagijo et al., 2023a). Primary outcomes were maternal and neonatal morbidity and start of breastfeeding. Secondary outcomes were health behavior, psychosocial outcomes, satisfaction, health care utilization and process outcomes such as attendance rates and number of women per session, which were collected through self-administered questionnaires, group-evaluations and individual interviews. To remove differences between gANC participants and control group as well as non-gANC participants and control group, caused by other factors than gANC, both intention-to-treat analyses and a per protocol analysis were performed comparing the three subgroups: control group, gANC-participants and non-gANC-participants, using multilevel techniques to account for clustering effects. Propensity score matching was used to remove differences caused by factors other than gANC. Data for the stepped-wedge cluster randomised controlled trial was collected from 2013 to 2016.

The online questionnaire aimed at Centering care providers, was carried out in 2020 specifically in support of this cost-benefit analysis (supplementary data 1). Invitations with appropriate link were sent by email to all midwifery practices offering gANC (response rate 45%, 89/200). All midwifery practices were trained in the Centering-based group care method during 2017 or earlier. Midwives included in the study were therefore experienced in providing gANC. Midwives were requested to estimate time invested in gANC during 2019, to ensure a realistic estimate and avoid the registration of higher time investments usually needed when new methodology or models are introduced (Levati et al., 2016). In addition, the survey gave insight into the number of gANC groups carried out annually as well as average group size. Existing literature was used for studies on long-term risks of disease.

Population

The costs and effects of gANC were calculated based on a hypothetical cohort of annually 12,894 women participating in gANC (Table 1). This number is based on a combination of the annual number of women starting in prenatal care in The Netherlands (140,000), the current capacity of gANC (150 of 570 midwifery practices) and the uptake of gANC (35 %) (Perined, 2018; Rijnders et al., 2019; Wagijo et al., 2023a,b). It was assumed that each pregnancy leads to the birth of one child. The ratio of nulliparous and parous women participating in gANC was set at 65:35, based on the trial results and an earlier Dutch

Table 1
Hypothetical year cohort.

Hypothetical year cohort	
Women starting prenatal care in primary care midwifery practice	140,000 ^a
Primary care midwifery practices offering gANC	150/570 ^b
Women having the opportunity to choose for gANC	36,842
gANC reach within midwifery practices offering gANC	35% ^{c,d}
Women receiving gANC prenatal care	12,894
Ratio nulliparous women to parous	65:35 ^{c,d}
Nulliparous women receiving gANC prenatal care	8381
Parous women receiving gANC prenatal care	4513

gANC= group antenatal care.
a. www.Perined.nl. Kerncijfers 2018. Last accessed 10–10–2022, b. www.nivel.nl Cijfers-uit-de-registratie-van-verloskundigen-peiling-jan-2018.pdf Last accessed 10–10–2022, c d. (Wagijo et al., 2023a, 2023b).

cohort study (Rijnders et al., 2019; Wagijo et al., 2023a, 2023b).

Time horizon

Only direct healthcare costs and all costs related to (future) healthcare usage, were included. The costs of gANC were calculated from 12 weeks gestation until 6 weeks postpartum. The time horizon for the economic consequences was set at 80 years, in accordance with Dutch average life expectancy. (Muiser, 2007; CBS, 2022). Costs were expressed in Euros (€) and appointed per 'patient', as healthcare in the Netherlands is financed by health insurers per patient (Dutch Institute National Healthcare, 2023). Costs were inflated using the 2019 consumer price index (Statline, 2022). In order to compare the differential cost of gANC with cost-savings, the future cost-savings were converted over time to the net present value by discounting at a rate of 4%, in accordance with Dutch guidelines for economic evaluations (Dutch Institute National Healthcare, 2023, Hakkaart-van Roijen et al., 2016).

Costing prenatal care

Primary antenatal care is part of basic health care in the Netherlands. The price of antenatal care is formulated within a maternity care tariff for the entire period of pregnancy, birth and postnatal period. This individual tariff is set annually by the Dutch financial governing body for health care, Dutch Healthcare Authority (NZA), and is reimbursed as such by all health care insurers (Muiser, 2007; Dutch Healthcare Authority, 2019). The tariff consists of an income part covering the midwife's time spent on care, and a cost part covering disposables, hygiene and office materials but also costs such as rent, employment costs of receptionist, insurance costs, (maintenance of) equipment etc. We used this tariff as a proxy for costs. To allow for a fair cost comparison, the same unit prices such as hourly rate for midwives and practice assistants, materials etc. were used for gANC and IC. All calculations were performed in Excel.

For gANC non-recurring costs related to implementation included a two-day training and three peer-to-peer review sessions for care providers, replacing personnel costs and materials needed to provide gANC. Capital costs and other venue related costs were excluded from the analysis, as these cost categories vary considerably between practices and are therefore not generalizable to all midwifery practices. Non-recurring costs were spread equally over a 5 year period.

The main recurring costs category for both gANC and IC were personnel costs of healthcare providers. The time investment for both alternatives were valued using average gross salaries and a markup of 39 % for premiums, social security and retirement (Statline, 2022). Gross salaries and reimbursement fees of healthcare providers were obtained via NZa. With the markup this came to a rate of €89.81 (income including overhead costs) per hour for a midwife and €48.49 per hour for a co-facilitator, equal to the rate of a maternity care assistant. In addition, supplies such as snacks, drinks and notebooks for participants were included in the cost computation for gANC (Table 2).

After valuing resources, the (time) volumes of resources were determined for both gANC and IC. Data on the volumes and values of resources were obtained from the online questionnaire, expert opinion from the Dutch Midwives organisation KNOV and NZa as well as the literature.

Estimating healthcare cost-savings

For health outcomes that differed significantly between IC and gANC or that showed a trend in the trial, the literature was searched to find relevant information on lifelong costs, risks and incidences of long term effects of disease, breastfeeding and lifestyle. The outcomes preterm birth or low birthweight were not used in this economic evaluation. Although some studies show a reduction in these outcomes in women who receive gANC, Dutch data amongst low-risk women does not

Table 2

Cost categories, units and prices gANC antenatal care.

Cost categories	Unit	Costs
Staffing costs per midwife	Per hour (remuneration & costs)	€ 89.81 ^a
Staffing costs co-facilitator	Per hour	€ 48.49 ^a
2-day training course, including 3 intervention sessions	Per training course/per (co-) facilitator	€ 695.00 ^b
gANC basic starter package	Per unit (package)	€ 250.00
Electronic sphygmomanometer	Per piece	€ 150.00 ^c
Location adjustment (extra chairs etc.)	Per practice	€ 200.00 ^d
Snacks	Per gANC group	€ 10.00 ^d
gANC patient manual	Per participant	€ 5.50
Average location rental	Per month	€ 250.00 ^d

gANC= group antenatal care.

a: Tariffs maternity care nurse, Prestatie- en tariefbeschikking kraamzorg - TB-REG-19624-01 - Nederlandse Zorgautoriteit (overheid.nl), Last accessed 27-09-2022. b: www.stichtingcenteringzorg.nl. Last accessed 27-09-2022. c. www.mediqmedeco.nl (prices 2019). d. Online questionnaire.

support this (Rijnders et al., 2019; Wagijo et al., 2023a,b). Subsequently the findings were combined with the results of the trial and healthcare cost-savings were calculated for the hypothetical gANC cohort and compared to those in IC. Specific assumptions and calculations for each effect of gANC are explained in the results section. Not all (pregnancy) outcomes could be translated into monetary terms, as some outcomes cannot be quantified, or relevant literature on costing information, incidences, relative risks and monetary value related to outcomes was limited. Therefore the outcomes on care satisfaction, pregnancy knowledge, postpartum alcohol consumption, parental efficacy and healthy eating and exercise were not included in the evaluation.

Indirect healthcare costs are costs related to the loss or reduction of work productivity incurred because of morbidity or mortality associated with a certain condition and are typically valued from either societal, individual, or employer perspectives (Hakkaart-van Roijen et al., 2016). These costs are not taken into account in this study.

Epidemiological and economic data to calculate the monetary benefits of gANC were obtained from the trial results and the literature. The monetary benefits of gANC were calculated in different ways, depending on the availability of information.

Sensitivity analysis

The choices and assumptions made in the economic evaluation created certain levels of uncertainty about the outcomes. To understand and express this uncertainty, deterministic sensitivity analyses were performed. Different scenarios tested the impact of variation in parameters used in the evaluation (Boccuzzi, 2003). First, an overview of the costs and benefits of gANC was created with different scenarios on the uptake of gANC. Next, the impact of discounting was calculated for future healthcare cost-savings. Furthermore, the minimum and maximum price of gANC was calculated by minimum and maximum time investments in gANC obtained via the online questionnaire. In the costing of gANC, the unit price for personnel costs of the co-facilitator was based on the hourly rate of a maternity care assistant in the Netherlands. However, instead of a maternity care assistant, another midwife, a student-midwife, nurse assistant or a volunteer can also be deployed as co-facilitator. Different co-facilitators are reimbursed at different rates, leading to different cost prices of gANC. There is no guideline on who can act as co-facilitator, it depends on the availability of resources and personal preference. The impact of different types of co-facilitators on the differential cost of gANC was estimated. Finally, costs and savings for different group sizes were calculated.

Results

Differential cost of Centering-based group care compared to individual care

IC usually consists of a booking visit, twelve individual visits and one 6-week postnatal visit to the midwifery practice (KNOV, 2022; Koster et al., 2015). Besides the booking visit and ten group sessions which includes the 6-week postnatal group session, women who receive gANC also attend 4.2 individual visits on average (Wagijo et al., 2023b). This is included in the costing of gANC. The average time investment of a midwife providing IC is 398 min per woman. The average time investment of a midwife (327 min.) and a co-facilitator (165 min.) combined providing gANC, amounts to 492 min per pregnant woman (Table 3). The extra time investment is attributable to the co-facilitator. The time investment of the midwife decreases from 398 min in IC to 327 min in gANC. Women in gANC receive about 8 h of care per person compared to about 6 h for women in IC. However because care is given in group sessions of 2 h each, women actually receive almost 22 h of care.

The time investment of the co-facilitator, the implementation costs and the equipment needed for gANC result in higher costs than those of IC: €642 per participant in gANC, compared to €596 in IC. The differential cost is €45 extra per person in gANC (Table 4, Supplementary data 2,3). When a student or volunteer is deployed as co-facilitator instead of a maternity care assistant, providing gANC is expected to be cheaper than providing IC (Table 5). Using a hospital midwife, health visitor, youth health nurse or practice assistant as co-facilitator will also lead to additional costs of gANC. Using a practice assistant or a maternity care assistant results in smaller additional costs.

Breastfeeding

Breastfeeding has a positive impact on both infant and maternal health, such as a reduction in infant mortality due to respiratory and gastro-intestinal infections and a reduced risk of breast and ovarian cancers (NICE, 2014). The trial showed that breastfeeding initiation rates were higher amongst nulliparous (78.7% vs 87.6%, Odds Ratio (OR) 2.23, 95% Confidence Interval (CI) 1.34–3.69) and parous women (71.7% vs 80.3%, OR = 1.62, 95% CI = 1.00–2.62) participating in gANC when compared to women in the control group receiving IC (Wagijo et al., 2023a). Büchner et al. carried out the only economic

evaluation on breastfeeding within the Dutch context (Büchner et al., 2007). It investigated the health effects of breastfeeding and related healthcare cost-savings using a model simulation to quantify the health effects of several policy interventions, the so-called Masterplan Breastfeeding, on the promotion of breastfeeding. In accordance with the Masterplan which estimated that 41% of mothers will breastfeed for at least six months, the model of Büchner et al. calculated that this will lead to healthcare cost-savings of €23.34 (price level 2019) per mother/child (Table 4). Dutch monitoring data from 2015 confirms the Masterplan estimate with a six-month breastfeeding rate of 39% (Peeters et al., 2015). This amount includes the savings due to reduced occurrence of disease related to breastfeeding, such as diabetes, obesity, cardiovascular disease (CVD) and some types of cancer (Chowdhury et al., 2015). This means that for one hypothetical cohort of 12,984 women receiving gANC (Table 1), healthcare cost savings are €313,839.96 (Supplementary data 4).

Pregnancy induced hypertension (PIH)

In gANC women were less likely to develop hypertension related problems compared to women in IC (nulliparous 7.9% versus 14.6% adj OR 0.53, 95% CI 0.30–0.94 and parous 3.3% versus 6.6% adj OR 0.66, 95% CI 0.24–1.82) (Wagijo et al., 2023a). Women with pregnancy induced hypertension (PIH) are at an increased risk of developing CVD later in life (Bellamy et al., 2007). CVD is the number one death cause in women in the Netherlands and is responsible for a large amount of the Dutch healthcare expenditure (RIVM, 2023a; Meerding et al., 1998). As such, this evaluation looked at PIH related CVD attributable healthcare costs in women. The risk factor PIH was linked to relative risks and incidences for CVD from the literature. Data from the Dutch Cost of Illness study were used to estimate annual healthcare expenditure for CVD per woman (Meerding et al., 1998). The numbers of prevented cases were multiplied by the annual healthcare costs per patient from age 50 (mean age onset CVD) to 81 years (life expectancy) to estimate lifetime healthcare cost-savings. After discounting (assuming a mean age of 30 years for pregnant women, total healthcare cost-savings related to CVD are estimated to be €1077,745 or €84 per woman receiving gANC. (Supplementary data 5).

Smoking

Smoking behavior during the trial decreased from 3.8% at intake to 1.9% at 36 weeks of pregnancy (OR 0.71, 95% CI 0.28–1.77) and 2.3% (OR 0.51, 95% CI 0.22–1.17) 6 weeks postpartum in the nulliparous gANC group, while it increased from 3.9% at intake to 4.9% (OR 1.21, 95% CI 0.49–3.04) at 36 weeks of pregnancy and 4.6% (OR 0.85, 95% CI 0.38–1.86) 6 weeks postpartum in the nulliparous control group (Wagijo et al., 2023b). For parous women the trial shows a small increase in smoking in the gANC group: from 2.0 & at intake to 2.6% at 36 weeks of pregnancy and 6 weeks postpartum) and an increase in IC: 3.7% at intake, 3.4% at 36 weeks of pregnancy and 4.5% at 6 weeks postpartum. In absolute numbers there is a reduction in smoking women of 350 who would have otherwise smoked if they had received IC. Of this group 25 women will start smoking again after 6 weeks postpartum (Supplementary data 6), making the final reduction 325 women.

We looked at the healthcare costs related to passive smoking in children aged 0–18 years. Approximately 22% of adults in The Netherlands smoke and it is estimated that 20–36% of Dutch children smoke passively, most often due to parental smoking (RIVM 2023b; Bommele et al., 2019; Kok et al., 2016). On this basis we calculated the extra healthcare costs to be €12.91 per child per year. After discounting this is €53,115 per cohort in healthcare cost-savings related to passive smoking in children or €4 per woman in gANC (Supplementary data 6).

In summary the additional costs of providing gANC are €45 per woman which are offset against expected benefits of €112.04 per woman in gANC, providing total savings of €67.02 When more women receive

Table 3
Time investment IC & gANC.

Cost category	Average volume in minutes in IC per pregnant woman ^a	Average volume in minutes in gANC per pregnant woman, based on a group of 10
Booking visit	40	40
Individual antenatal consultation	17 (*12 visits)	17 (*4.2 visits)
gANC midwife		120 (*10 meetings)
gANC co-facilitator		120 (*10 meetings)
Preparation Midwife		52 (SD 18) ^b (*10 meetings)
Preparation co-facilitator		22 (SD 7.5) ^b (*10 meetings)
Administration & evaluation of care Midwife	12.3 (*9)	44 (SD 18) ^b (*10 meetings)
Administration & evaluation of care co-facilitator		23 (SD 11) ^b (*10 meetings)
Pre-labor information consultation	16	Included in 10 sessions
6-week postnatal check-up	27	Included in 10 sessions
Total time investment per midwife per client	398 min	492 min. (midwife 327 /co-facilitator 165)

IC= individual care, gANC=group antenatal care, SD= standard deviation.

^aKoster L, Batterink M et al. 2015 (31). ^bdata from online questionnaire.

Table 4

Healthcare costs and savings per woman per cohort year and per percentage of participants (scenario's).

Category	Per woman	Cohort	Scenario 1 (35% women receiving gANC)	Scenario 2 (60% women receiving gANC)	Scenario 3 (100% women receiving gANC)
<i>Costs</i>					
IC	€596.-	€7684,224	€29,201,719	€50,060,090	€83,433,483
gANC	€642.-(Range: €578 – €710)	€8264,682	€31,407,586	€53,841,575	€89,735,960
<i>Additional costs of gANC</i>	€45.-(Range -€18-€114)	€580,458	€2205,866	€3781,485	€6302,476
<i>Benefits</i>					
Breastfeeding*	€23.34	€313,839.96	€1192,660	€2044,560	€3407,600
PIH related CVD*	€84.-	€1077,662	€4095,350	€7020,601	€11,701,001
Passive smoking*	€4.-	53,115	€201,849	€346,028	€576,713
<i>Total benefits</i>	€112.04	€1444,617.43	€5489,859.95	€9411,188.49	€15,685,314.15
<i>Total savings</i>	€67.02	€864,159.	€3283,993.46	€5629,703.08	€9382,838.47

gANC=group antenatal care, IC=individual care, PIH=pregnancy induced hypertension, CVD=cardiovascular disease. *Discounting included. Amounts without discounting are as follows: PIH related CVD €3872,954 and Passive smoking in Children up to age 16 yrs. €72,317. Discounting (3%) was already applied to breastfeeding related healthcare costs in the RIVM study used for this evaluation: costs without discounting were unavailable.

Table 5

Costs of gANC according to different co-facilitators.

Type of co-facilitator	Costs per minute	gANC costs per pregnant woman
Maternity care assistant (baseline)	0.81	44.00
Student midwife	0.13 ^a	−68.64
Hospital midwife	1.43 ^b	149.49
Volunteer	0.600	−90.75
Health visitor/youth health nurse	1.10 ^c	74.05 ^d
Practice assistant	0.73 ^e	31.00

gANC=group antenatal care.

a: Via Gemiddelde vergoedingen stagiaires (salarisnet.nl) (remuneration interns). Last accessed 14–02–2023. b Hakkaart et al. (27)., 2016. c Via “De jeugdgezondheidszorg in kaart(mapping youth health care)”, Actiz, 2012. d We deducted 20 min of time spent on individual visits in regular care. e Personal communication KNOV (Dutch Org.Midwives).

gANC, total costs savings will be even greater, with a maximum of more than 9 million euro's in cost savings if 100% of women receive gANC (Table 4).

Sensitivity analyses

Based on the maximum and minimum time investments in gANC obtained via the online questionnaire, the maximum costs of gANC are €710 per person (Table 4), resulting in maximum differential costs of €114 per person. The minimum costs of gANC are €578 per person, which results in direct savings of €18 per woman compared to IC in addition to estimated future health care cost-savings of €112 per woman. Maximum differential costs of €114 per person for providing gANC, may result in € 1.82 additional costs per person.

Discussion

This exploratory economic evaluation provides the first insight into the financial aspects of Centering-based antenatal group care or gANC in a low risk population in the Netherlands. Although providing gANC comes at an extra cost of €45 per woman compared to IC, women receive about 15 h more care than they would in IC: the differential costs of providing gANC are therefore only a marginal investment. Moreover, this evaluation shows that gANC might lead to a reduction in future healthcare utilization, saving €112 per woman receiving gANC which amounts more than 1.4 million euros in costs for the hypothetical annual cohort. Although when differential costs are set at a maximum, the costs of gANC are €1.82 more, this amount is negligible in view of the myriad

of benefits that were not taken into account because we were unable to monetize them. The investment of providing gANC is therefore compensated by future healthcare cost-savings, resulting in net savings of almost 900,000 euros per cohort, or on average €67 per woman in gANC.

Strengths & limitations

The strengths of this economic evaluation lie in the fact that we were able to use the data of a recent stepped wedge trial carried out in the Netherlands comparing the outcomes of gANC to those of IC. However, not all outcomes of the trial could be quantified and monetized into future healthcare costs or cost savings. The outcomes “experience with prenatal care”, “pregnancy knowledge”, “parental efficacy” and “healthy eating and exercise scores” were significant results of the trial but are not transferable into financial terms. Although gANC shows an improvement in lifestyles with regards to smoking, alcohol consumption, diet, start of breastfeeding, available data are limited. Although Büchner's results suggest that most health improvement could be won and health care costs could be saved when more women start breastfeeding instead of *prolonging* the breastfeeding period for women who already give breastfeeding, more data such as the effect of gANC on duration of breastfeeding and postpartum smoking, are needed to further calculate and estimate health care cost-savings related to the positive effects of gANC (Büchner et al., 2007). Furthermore, discounting of future health care savings to their present value was set at a relative high rate, all together leading to conservative estimates. We can therefore reasonably assume that calculated savings are minimum estimates and could potentially be larger than reported in this study.

Guidelines on health economic evaluations recommend applying a societal perspective, meaning all cost and benefits should be included regardless of who incurs the costs and who obtains the benefits (Dutch Institute national Health care 2016; Hakkaart-van Roijen et al., 2016). The perspective applied in this study was set to the health care sector, limiting the captured costs and benefits. Previous studies have shown that societal benefits of improving health behavior can provide substantial savings and benefits to society at large (Cadilhac et al., 2011). For example, the estimated societal benefits of increased smoking cessation in pregnant women are very high and reducing alcohol consumption in the Netherlands is associated with billions of euros in savings (Prah Ruger Emmons, 2008, RIVM, 2016).

The main cost driver in the cost analysis of antenatal care is the cost of personnel. We only included midwifery practices experienced in providing gANC to generate data on time invested to provide gANC, increasing the reliability of the results based on process fidelity as suggested by Novick et al. (Novick et al., 2013). On the other hand, measuring actual time investment of health care providers could have

been more accurate than the self-reported results from the online survey. However, when the upper values of the reported time investment were used to calculate the cost of gANC, the estimated health care cost-savings still compensate the extra cost of gANC.

The volumes, i.e. time investment, for personnel costs were varied in the sensitivity analyses. The rates for personnel costs also vary among different sources. Dutch economic evaluations in health care use various rates for health care providers: e.g. in studies concerning midwives an hourly rate is used which varies between €35 and €86 (Freeman et al., 2018; Hendrix et al., 2009). The rates used in this study are in line with the 2020 unit prices set by the Nza, causing costs most probably to be overrated compared to savings based on 2019.

In addition to personnel costs, group size is an important variable in determining the costs of group care. Higher costs are likely to negatively affect implementation and sustainability of the model (Novick et al., 2015). Fortunately both variables can be influenced to a certain degree by those who organize gANC. However, group size and personnel costs may also be influenced by experience. When starting gANC, midwives may find it difficult to reach sufficient women in their practice or they may want to facilitate the first groups with another midwife as opposed to a maternity care assistant, in order to feel more supported and more secure in their new role as facilitator.

Input data to assess health care savings were obtained via the literature. Due to limited availability of data within the specific Dutch context, international findings were used. These findings may not be fully applicable to the population of interest in this study.

As previously mentioned, not all results of the trial were taken into account to calculate the potential returns of gANC, such as satisfaction with care. Women who receive gANC are known to be more satisfied with their care, feel more involved in their care, and have been shown to be more resilient (Rising, 1998; Cunningham et al., 2017). Although these outcomes are difficult to quantify and convert into financial values, they are important aspects of quality of care as they offer information on care provider's success at meeting relevant client expectations while providing a key determinant of clients' prospective behavioural intentions. As such client satisfaction is correlated with important outcomes such as compliance, health service utilization and pregnancy outcomes and could therefore potentially further influence health care costs (Xesfingi, Vozikis, 2016, Aditi Naidu, 2009; Huang et al., 2004). For this evaluation implies at the very least that with a relatively unfavorable cost scenario and a conservative estimate of future health care cost-savings, gANC is at least cost neutral. On the other hand it is probably more likely that gANC leads to actual cost-savings, indicated by the positive trends seen in smoking and alcohol consumption and related societal benefits (Kok et al., 2016; RIVM, 2016).

This study contributes to the international body of evidence on Centering-based group antenatal care, as it is one of the few studies giving a financial perspective on this antenatal care model. Although health care organization, financing and the effects of gANC differ per context, the financial model can be adapted and applied to other contexts.

The positive insights into the financial aspects of the innovative antenatal care model as provided by this study, further support its implementation. However, reimbursement of antenatal care needs to be explored as the higher gANC costs are carried by individual care providers in the Netherlands while benefits are gained by health care services and society at large. We therefore recommend a further exploration of a variety of financing options to benefit gANC, as both national and international studies have shown that the model leads to significant added value of prenatal care by improving health and psychosocial outcomes, client experience and provider satisfaction.

Conclusion

This economic evaluation indicates that gANC is more costly to

provide than IC due to the involvement of a co-facilitator, additional individual antenatal visits and implementation costs. These differential costs are very likely to be compensated by future health care cost-savings related to reduced prevalence of PIH, increased rates of breastfeeding and reduced smoking prevalence among women in gANC. To investigate possible wider cost-implications, future studies should conduct additional analyses on cost-savings and collect follow-up data to strengthen the financial evidence.

Authorship

Suze Jans, Xanne Westra, Matty Crone, Elske van den Akker-van Marle and Marlies Rijnders contributed to the conception and design of the study; the acquisition of data, and all authors made substantial contributions to the analysis and interpretation of data, drafting the article and revising it critically for intellectual content. All authors approved the final version that was submitted to Midwifery and abide by the copyright terms and conditions of Elsevier. All authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Suze Jans and Xanne Westra are joint first author.

Availability of data and materials

Data and raw materials are available on request via corresponding author and TNO Child health

Ethical approval

The Trial study was approved by the Commission of Medical Ethics of the Leiden University Medical centre (NL44319.058.13). The trial was registered at the Dutch Trial Register (Nederlands Trial Register): NTR4178 (September 17th 2013). Ethical approval for the economic evaluation was submitted to the TNO ethics committee, including the questionnaire, but was deemed not necessary.

Author agreement

This manuscript / study is the author(s) original work which has not received prior publication and is not under consideration for publication elsewhere.

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Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Marlies Rijnders is a board member of Group Care Global.

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Supplementary materials

Supplementary material associated with this article can be found, in

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