Safe motherhood : severe maternal morbidity in the Netherlands. The LEMMoN study

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CHAPTER 12

General discussion

The LEMMoN study has provided an invaluable amount of obstetric epidemiologic data. The headlines are described in this thesis, and there are still many more publications to follow within the next years. Until now, data on the incidence of severe acute maternal morbidity (SAMM) in the Netherlands were scarcely available. Although the Netherlands has an excellent reputation regarding assessment of maternal mortality, the small numbers involved will not likely change clinical practice much on the short term. In order to improve care and make pregnancy even safer, there is a clear need in the Netherlands and other high income countries to extend routine data collection to also include the severest forms of SAMM.

International comparison

Data on SAMM in high income countries are increasingly published in the literature.[1-10] We recently published an overview of the various aspects of it.[11] Population-based studies till date are summarised in table 1.

Table 1. Severe acute maternal morbidity (SAMM) in high income countries, population-based studies*

Country	Year	Number of births	Rate of SAMM per 1000 births	CFR
Prospective studies, purposive case finding				
UK, South East Thames[3]	1997-1998	48,865	12.0	0.9
Scotland[1]	2001-2002	51,165	3.8	2.0
Ireland, Dublin[6]	2004-2005	49,829	3.1	1.3
The Netherlands	2004-2006	358,874	7.1	1.9
Retrospective studies, register-based				
Canada[7]	1991-2000	2,548,824	4.4	0.8
Finland[9]	2002	53,568	7.6	
USA[4]	1991-2003	50,600,000	5.1	2.0
Australia, New South Wales[2]	1999-2004	500,603	12.5	

*** nationwide unless otherwise stated**

Incidences range from 3.1 in Ireland to 12.5 in Australia, the differences largely depending on different inclusion criteria. All studies reported MOH to be the most important cause of SAMM. This subgroup also happens to be mostly prone to difference in inclusion criteria. In Scotland and Ireland, women were included only after transfusion of five units of red blood cells. In Australia and the UK, however, women with obstetric haemorrhage were included irrespective of their transfusion needs. In a one-to-one comparison of the raw data of the Scottish study and ours, we found that the difference in SAMM rate was fully explained by the different inclusion criteria

for MOH. Our inclusion criteria for MOH were in between the mentioned ones, and so was our incidence. A fair comparison of incidences in order to compare quality of care between countries is still hampered by differences in inclusion criteria of SAMM. The first step towards universal registration of SAMM as quality parameter of obstetric care is the introduction of internationally agreed criteria for SAMM. Currently, the World Health Organisation is in the process of formulating such criteria for international use.[12] In light of the large differences in obstetric practice between countries, organ system based criteria are recommendable to optimise comparison. However, case ascertainment based on such criteria is more difficult because standardised laboratory and vital parameters are required. This involves detailed documentation of cases, which is not always warranted outside the context of research purposes. For comparison between high income countries, with more comparable health care practices, it may be more efficient to use disease-specific and management based criteria as we did. This will certainly enhance participation rates at the cost, however, of completeness and data quality. As resources for epidemiologic data collection are scarce in the Netherlands, it is of vital importance to keep local time investment for data collection to a minimum. Time consuming procedures will inevitably lower participation rates. The final best way to collect data on SAMM remains to be determined.

Temporal trends in SAMM

There is alarming evidence that the incidence of SAMM is increasing. The retrospective register-based studies from Canada, Finland, the USA and Australia shed some light on this increase during the last two decades (Table 2).[2;4;7;9;10] In Canada, overall maternal morbidity seemed similar during 1991–1993 (4.40 per 1000 births) and 1998–2000 (4.25 per 1000 births).

Table 2. Temporal trends in severe acute maternal morbidity (SAMM) in high income countries*

Country	Period	Rate of SAMM per 1000 births	Increase
Canada[7]	1991-1993	4.6	0%
	1998-2000	4.6	
Finland[9]	1997	5.9	29%
	2002	7.6	
USA[4]	1991-1994	4.5	31%†
	1995-1998	4.7	
	1999-2003	5.9	
USA[10]	1998-1999	6.4	27%
	2004-2005	8.1	
Australia, New South Wales[2]	1999	11.5	21%
	2004	13.8	

***only retrospective, register-based studies available; †P for test of trend: 0.002**

However, a closer look at the numbers revealed that incidences of the severest forms of maternal morbidity had all increased. Higher rates of venous thrombo-embolism (RR 1.7; 95% CI 1.3–2.2), cerebrovascular disorders (RR 1.4; 95% CI 1.1-1.8), uterine rupture (RR 1.6; 95% CI 1.4–1.8), acute respiratory distress syndrome (RR 1.5; 95% CI 1.1–2.1), pulmonary oedema (RR 2.1; 95% CI 1.6–2.7), myocardial infarction (RR 3.7; 95% CI 1.2–11.4), haemorrhage requiring hysterectomy (RR 1.8; 95% CI 1.5–2.1) and assisted ventilation (RR 2.5; 95% CI 1.9–3.2) were observed. These higher rates were balanced by an apparent decrease of the rate of haemorrhage requiring transfusion, possibly reflecting a more restrictive use of blood products instead of a true decrease of the rate of haemorrhage. Adjustment for maternal age, multiple pregnancy and previous caesarean section did not change these overall results. Contrastingly, in Australia, a significant increase of overall SAMM was found to be fully explained by an increase in haemorrhage requiring transfusion. In Finland and the USA, rates increased by 27-31% during a 5-12 year period. In the Netherlands, a clear increase of the incidence of obstetric haemorrhage (>1000ml) from 5.0 to 7.5% during a 10-years period can be seen from the Dutch Perinatal Database statistics [personal communication]. One should be aware of the fact that all these studies used administrative data. Coding errors are known to occur to a certain degree in such studies, but in all studies an increasing trend is observed. Until date, prospectively collected data on temporal trends of SAMM are scarce. The only data we know of are from Scotland. In the 2006 annual report of the Scottish Confidential Audit of Severe Maternal Morbidity, a non-significant increase was reported from 5.4 per 1000 (95% CI 4.9-6.0) in 2003-2005 to 6.4 per 1000 (95% CI 5.8-7.1) in 2006.[13] The rate of major obstetric haemorrhage increased significantly from 3.7 per 1000 (3.4-4.0) to 5.0 per 1000 (4.4-5.6) during the same period as did the rate of acute respiratory distress syndrome. One of the American studies performed multivariable logistic regression and found out that the increase of incidence was mainly explained by the increase in caesarean delivery rate from 21.2% in 1998 to 31.1% in 2005.[10] The increase was not related to age or multiple births. The influence of ethnicity, body mass index, pre-existing maternal conditions and quality of care were not investigated. Future assessment of the incidence of SAMM in the Netherlands could confirm the increasing incidence in a prospective manner not relying on administrative data which are prone to coding errors. Furthermore, it would provide more insight into the reasons for the apparent increase.

High incidence of eclampsia

Rates of eclampsia have decreased in high income countries since the publication of the Collaborative Eclampsia trial (1995)[14] and the Magpie trial (2002)[15], advocating the therapeutic and prophylactic use of magnesium sulfate.[1;16] We found that the rate of eclampsia in the Netherlands appeared to be relatively high, even when compared to rates of the pre-magnesium sulphate era. When compared with the more recently published studies in the United Kingdom

and Scotland, our incidence seemed to be twice as high.

Substandard treatment of hypertension was found in at least 60% of eclamptic women and magnesium sulphate for seizure prophylaxis was administered in only 10% of these cases, although we classified 47% of cases as severe preeclampsia already on admission. Additionally, we found substandard care in 15 of 18 cases during extensive auditing. Evidence of substandard treatment of hypertensive disorders in pregnancy in the Netherlands is accumulating. It was highlighted already in 1998 based on the confidential enquiry into maternal deaths in the Netherlands.[17] More recently, maternal mortality due to hypertensive disorders in the Netherlands was reported to be three times as high as in the UK[18], with substandard care being present in 26 of 27 cases.[19] Gestational age at delivery in women with hypertensive disorders is three weeks higher in the Netherlands as compared with the UK, reflecting the too expectant management and underestimation of maternal risks by Dutch obstetric caregivers. Very recently, the Hypitat trial showed that induction of labour as compared to expectant management in women with mild hypertensive disorders at term yields better maternal outcome with a reduced caesarean section rate and comparable fetal outcome in the Dutch situation.[20]

Thanks to this accumulation of evidence, we have the impression that there is a growing awareness among Dutch obstetric caregivers, that has already lead to changing practice. The thresholds for treatment with anticonvulsive and antihypertensive medication have lowered and labour is induced earlier. The dogma that the foetus must reach term at any cost has been broken. Future assessment of the incidence of eclampsia is mandatory and will hopefully confirm the changes in management.

Intensive care unit admission

The rate of intensive care unit (ICU) admission in the Netherlands appeared to be 2.4 per 1000 deliveries. This is in the lower range of what is reported in the literature. Only few other studies reported population-based incidences of ICU admission, which are likely lower as compared to facility-based (often tertiary care) studies. This is also the case when comparing our results with an earlier study of ICU admissions in our own tertiary care centre, in which a three times higher incidence was reported.[21] Our finding that only a third of all cases of SAMM were admitted to ICU is consistent with that of the Scottish population-based study.[1] The important implication of this finding is that ICU admission rates cannot be used as a proxy of SAMM rates. It may, however, serve as a proxy for the most severe cases.

Moreover, ICU admission should not be merely used for (international) comparison of SAMM since it is a management based criterion subject to local, national and temporal differences in admission policy. This is illustrated already within the Netherlands by the great variation in ICU

admission rates by volume of hospital. Smaller hospitals showed a higher admission rate, but cases seemed less serious.

In light of the relatively high case fatality rate, proper management of obstetric ICU admissions requires intensive cooperation of intensivist/anaesthesist and obstetrician/perinatologist. Both their expertises are indispensable to deliver the high quality of care that is needed in these specific circumstances. Due to the rarity of obstetric ICU admission in high income countries, exposure of those clinicians to obstetric critical care is low. This would plea for centralisation of obstetric care, which is currently a hot issue in the Netherlands. Although underexposure to rare but life threatening complications might affect quality of care, this has to be balanced against the disadvantage of larger distances to obstetric services, which involves many more pregnant women. Timely referral of women with an (imminent) severe complication of pregnancy to a better equipped centre currently serves as the best compromise. Availability of an on-site intensive care unit, an on-site blood bank, an intervention radiologist, an on-site anaesthesiologist, obstetrician and neonatologist 24 hours a day, a cell-saver, and specific experience, as well as the distance to the nearest higher level of care, all have to be taken into consideration when deciding what is the safest location to treat the woman.

Major obstetric haemorrhage

MOH appeared to be by far the most important cause of SAMM. From the perspective of maternal deaths in the Netherlands, the large clinical impact of MOH was somewhat surprising since MOH is not a major cause of maternal mortality in the Netherlands anymore.[22] To illustrate the problem: the cases included in the LEMMoN study were transfused over 10,000 units of packed cells for an estimated 4.7 million litres of blood loss. Women received up to 50 units of packed cells. The general availability of safe blood products in the Netherlands has been one of the major reasons for the decline in maternal deaths in the past century. From our data, it is estimated that the maternal mortality ratio would have been seven times higher in the absence of blood transfusion, with much larger implications yet to be expected for the number of SAMM cases.[E. Briët, communication] Concerning the maternal mortality ratio, this would have left our country between some low or middle income countries like Iran, Northern Korea, Turkey, Argentina and Russia.

We found retained placenta/placental remnants to be the most important cause of MOH. This is in contrast with data presented in various obstetric text books, which report uterine atony to be the most important cause of obstetric haemorrhage. Although contradictory at first sight, this difference is well explained by the fact that uterine atony can be relatively easy managed with uterotonic agents and hence will not often reach the threshold for MOH. Vice versa, MOH mostly results from an identifiable cause. Local protocols should include a flow chart to identify and treat

this cause as quick as possible.

International comparison of rates of MOH is hampered by large differences in inclusion criteria as already discussed. Hysterectomy was one of the criteria used in the recently published Peristat-II report in a first attempt to quantify and compare SAMM in the 25 countries of the European Union and Norway.[21] Rates varied from 0.2 to 1.0 per 1000 deliveries, our hysterectomy rate of 0.3 per 1000 being among the lowest. Comparison is hampered by absence of data on arterial embolisation preventing hysterectomy and subsequent loss of fertility. In the Netherlands, both procedures are carried out with a similar frequency, with failure of embolisation occurring in about 15% of cases eventually resulting in hysterectomy. We are not aware of the availability of such data for other countries.

We also included ten Jehovah's witnesses in the LEMMoN study. Refusal of blood products implies a serious danger of life. Jehovah's witnesses obviously have an increased risk of experiencing maternal mortality and SAMM.[22] Using data of the LEMMoN study, this risk was estimated to be 1.4% which is three times higher than in the general pregnant population.[23] The fact that a home delivery was planned in one woman illustrates the underestimation of the risk by health care provider and patient.

Ethnicity

Increased risk for non-Western women to experience SAMM was present among all categories of SAMM, although relative risks were lower than previously reported for maternal mortality.[5;22] Great differences in risks of SAMM were found between the distinct ethnic groups in the Netherlands. Turkish and Moroccan women showed relative and absolute risks comparable to Western women, while sub-Saharan African women showed a three to six-fold increased risk among the different SAMM categories. Very recently, a comparable study was published on ethnic variation in SAMM in the United Kingdom.[26] Although this study only concerned some specific subgroups of SAMM, the results are largely comparable. Like in the present study, black African (~sub-Saharan African) and black Caribbean (~Surinamese and Dutch Caribbean) women had the highest risks.

The increased incidence of SAMM among non-Western immigrants found in this study may be explained by genetic, socio-demographic and lifestyle related differences, but there are also several factors related to immigration that possibly influence the risk of SAMM. The role of these factors is difficult to quantify in comparative studies as indigenous women are not exposed to these risk factors. Like other studies, we found low socio-economic status to be the most important independent risk factor for SAMM in multivariable analysis. However, Turkish and Moroccan immigrants in the Netherlands did not show increased risks of SAMM despite their relatively low SES. Therefore, the explanation for the differences in risk of experiencing SAMM should rather

be sought in factors related to immigration and integration. Data from the qualitative part of the LEMMoN study suggest that the strong social-ethnic networks and collectively shared experiences with the Dutch health care system of Turkish and Moroccan immigrant populations seem to prevent them from developing SAMM.[27] Even though many Turkish and Moroccan women have recently come to the Netherlands due to family reunion or marriage, their risk was not increased despite frequently observed language barriers and acculturation problems. Contrarily, relative risks were highest in women from the smaller ethnic minority groups (sub-Sahara Africa and Middle East) who more recently arrived in the Netherlands. This possibly results in a weak social network and inadequate knowledge of the health care system, contributing to the increased risk. Other disadvantages related to recent arrival in the Netherlands are an illegal status, health insurance problems, communication barriers and inadequate health skills to participate in the interaction with health care providers.[27]

Underreporting

In view of the significant underreporting of maternal deaths to the Maternal Mortality Committee, we spent much effort in assessing the degree of underreporting to LEMMoN.[28] Rates of underreporting found for the different categories of SAMM are shown in table 3. There was no source available for assessment of the underreporting of ICU admission. For uterine rupture and eclampsia, underreporting appeared to be very low as compared to the Dutch Perinatal Database (LVR-2).[29] For MOH, underreporting appeared to be 35% in a large national survey among blood transfusion laboratories. However, sub-analysis revealed that the majority of cases not reported to LEMMoN concerned relatively mild cases of MOH. Only three very severe cases (>10 units of red blood cells) were found to be not reported to LEMMoN, and no underreporting of hysterectomy or arterial embolisation was noted.

Table 3. Rates of underreporting to LEMMoN

SAMM category	Method and period of assessment	Rate
ICU admission	None available	-
Uterine rupture	Dutch perinatal database, Aug 04-Dec 04	2%
Eclampsia	Dutch perinatal database, Aug 04-Mrch 06	3%
Major obstetric haemorrhage	National sample of blood bank databases, Aug 04- Mrch 06	35%

The results of the survey suggest that data of local blood transfusion laboratories are helpful in identifying cases of SAMM, but identification of all cases through local transfusion databases is not feasible as the pregnant status of women is often unknown. It should not be too difficult to overcome this problem as this information is usually supplied upon each request of blood products by the

clinician. In some hospitals, the local coordinator already included data from the blood transfusion laboratory in his/her strategy for identification of cases, resulting in low rates of underreporting.

Mode of delivery

One of the most important explanations for the increasing incidence of SAMM in high income countries is the increasing caesarean section rate.[2;10] Table 4 summarises the relative risks of caesarean section, prelabour caesarean section and caesarean section in the obstetric history for different types of SAMM.

Table 4. Unadjusted risks of caesarean section (CS) for different types of SAMM

	CS overall	prelabour CS	previous CS
Severe acute maternal morbidity	5.2 (4.8-5.6)	4.6 (4.2-5.0)	3.7 (3.4-4.1)
ICU admission	7.7 (6.7-8.8)	7.2 (6.3-8.4)	1.5 (1.3-1.9)
Uterine rupture	n/a	n/a	65.1 (42.9-98.7)
Eclampsia	2.2 (1.3-4.0)	3.7 (1.9-7.0)	n/a
Major obstetric haemorrhage	3.1 (2.8-3.5)	3.0 (2.6-3.5)	2.9 (2.5-3.3)
Hysterectomy/arterial embolisation	6.6 (5.0-8.7)	5.0 (3.6-6.9)	3.3 (2.4-4.5)
Sepsis[30]	2.2 (1.3-4.0)	3.6 (1.9-6.9)	n/a

It is important to realise that caesarean section could be the cause of SAMM, but it could also represent the result of it, as it is often performed because of the compromised maternal condition resulting in inclusion into the LEMMoN study. Therefore, further analysis is currently performed to shed more light on the risk of SAMM directly attributable to the mode of delivery. This will reveal information that is crucial to the appropriate counselling of women in whom an (elective) caesarean section is planned. Keeping the caesarean rate as low as possible is one of the most important challenges of present-day obstetric care. Each obstetrician has to be aware of and take into account the possible long term consequences of the decision to perform caesarean section. The WHO recommendation that a population based caesarean rate between 5 and 15% is optimal, is not met anymore by most high income countries.[31] The relatively low caesarean rate in the Netherlands should be embraced as a great achievement which protects Dutch mothers and newborns against SAMM and mortality.

Audit

Audit of SAMM is highly instructive and feasible albeit time consuming. Preparation and organisation of regional or national audit meetings appeared to be laborious and time-consuming. The rate of substandard care found during SAMM audit meetings was 80% as compared to

25% reported in perinatal audit in the Netherlands.[32] This clearly highlights the urgent need for improvement of quality of obstetric care and this could be achieved through audit. We recommend routine audit of all cases of SAMM at the local level. This involves about one case per month for the average obstetric team, and could be implemented as a purposive annual audit meeting, as part of a meeting of the regional obstetric cooperative ['verloskundig samenwerkingsverband'], or as part of daily staff meetings whenever a case presents. The standard substandard care forms used in the LEMMoN study and derived from that used by the maternal mortality committee, could be used (Appendix B). With great interest, we await the first results of the Dutch Perinatal Audit, which will shortly have its kickoff. Results and experiences could be used for future implementation of more audit meetings at a regional or national level. To optimally disseminate the lessons learned from SAMM audit, it would be valuable to assemble an instructive training programme containing the most instructive cases of SAMM in the form of (anonymised) case vignettes.

Differences within the Netherlands

We noted marked differences in incidence of SAMM and other specific severe maternal conditions throughout the country. Although based on these findings, it would be interesting to be able to draw conclusions about quality of care delivered, there are multiple other explanations for the differences. The most important are the use of management based criteria subject to local differences in practice, differences in patient population and differences in case ascertainment. However, keeping these limitations in mind, we think it is possible to draw some conclusions from the numbers in individual situations. Moreover, the results should encourage obstetricians at the local level to audit their cases for better interpretation of the numbers, next to the important aspect of learning from adverse events. For better interpretation of differences in results found in the LEMMoN study, it would be very interesting to use the Dutch VOKS methodology to correct incidences for case mix.

Home delivery

From an international perspective, the Dutch obstetric care system is rather particular because of its two-tier system (primary vs. secondary/tertiary) and the high rate of home delivery (about 30% of all births). This particular character of Dutch obstetric health care obligates us to provide evidence that the system is equal to or even better than other international systems in use. For this reason, extensive sub-analysis of cases of SAMM that developed under primary care was initiated. The results of this sub-analysis are pending and are beyond the scope of this thesis. However, based on our own findings, we conclude that the Dutch system of selection of low-risk pregnancies is functioning properly. Due to careful risk selection during pregnancy and delivery, only 9.3% of

women included in LEMMoN (excluding early pregnancy) were under primary care at the moment SAMM arose, and only 6.3% delivered at home. The relative risk of SAMM in home delivery was 0.1 (95% CI 0.1-0.2), reflecting a ten-fold decreased risk as compared to women under care of the obstetrician for any medical reason. A similar pattern is observed when looking at the rate of women primarily under responsibility of an obstetrician. This rate was 35.8% among women included in LEMMoN, as compared to 14.3% in the general pregnant population.

Preliminary data suggest that there was no difference in SAMM rate between women with low-risk pregnancies delivering at home and women with low-risk pregnancies delivering in hospital to their own choice under responsibility of a primary care giver, suggesting that the delay in reaching the hospital does not essentially add to SAMM.[32] There are obviously some examples where this type of delay played a role in the developing of SAMM, but numbers appeared to be small. Women with an indication to deliver in hospital under responsibility of a primary care giver based on their general or obstetric history ('medium risk') indeed had an increased risk of developing SAMM, mainly due to MOH [Masterthesis JAJM Mesman, 2009, unpublished].

Despite the absence of a crucial role for the Dutch risk selection system in the rate of SAMM, we emphasize that a two-tier based system is prone to substandard care on theoretical grounds due to discontinuity of care. Each referral moment has an inherent risk of suboptimal transfer of information and it is therefore of crucial importance in the current Dutch system to warrant optimal cooperation between health care providers involved in the obstetric chain. Suboptimal cooperation between primary care givers and obstetricians will undoubtedly result in substandard care and hence increasing risk of SAMM. Finally, it is of crucial importance to strictly adhere to the risk selection protocols to warrant personalised optimal care for each pregnant woman. High-risk pregnancies are better cared for in secondary and tertiary care, low-risk pregnancies are better cared for in primary care.[33]

Definition of SAMM

Definitions constitute one of the biggest challenges of the international study of SAMM. There is, however, a clear need for internationally comparable data on SAMM in high income countries since maternal mortality has dropped to very low levels. Different research groups have already addressed this issue.[1;3;12;34-37] The quest was started by Mantel et al. in 1998 in South Africa, who first proposed to extend the 'learning-from-adverse-events-thought' to include SAMM.[36] He promoted the use of organ system based criteria instead of management based criteria, because the latter largely depend on local policies which may largely differ between (and within) countries. The major objection to organ system based criteria, however, is that they require more extensive documentation of cases, which is not routinely performed

outside the context of research. Moreover, conditions such as eclampsia are not straightforward to define in terms of confirmable organ dysfunction. This was illustrated by comparison of cases of eclampsia included in the Netherlands and the United Kingdom, revealing that 31 Dutch cases of eclampsia would not have been included in the UK study because abnormal laboratory values could not be confirmed (chapter 5).

Enquiries into maternal mortality have taught us that clear definitions are crucial for national and international comparison of data. Compared to maternal mortality, much more difficulty is encountered in defining SAMM. Even though maternal mortality itself is a straightforward definition –there is little discussion whether a woman is dead or not-, the exact classification of maternal death (direct, indirect, late, fortuitous) appears difficult. This applies even more to SAMM.

The inclusion criteria we adopted in the LEMMoN study were appropriate to identify SAMM in the Netherlands. Among 23 cases that were extensively audited by an expert panel, 71% of cases were classified as true severe maternal morbidity.[37] Depending on the severity of cases that needs to be identified, one could consider restricting MOH to only those women in need of five instead of four units of packed cells. This would halve the total number of cases included, thereby optimising specificity at the cost of sensitivity (i.e., identified cases are more severe, but some severe cases are likely to be missed). These considerations are well addressed by Geller et al, who aimed to define a conceptual framework of SAMM.[35;39]

The group of 'Other severe maternal morbidity' gives us a valuable insight into what type of different SAMM would have been missed. This group would not be suitable for use in international comparison because inclusion is largely subjective. Large differences in inclusion of cases into this group were already noted between the eight academic teaching hospitals in the Netherlands, rates ranging from 4 to 34% of all cases. These rates probably importantly depend on the ICU admission policy: the stricter the policy of ICU admission, the more cases of SAMM will be left to include as 'other severe maternal morbidity'. It would be interesting to further analyse cases included in the miscellaneous group to get more insight into what cases would have been missed in the absence of a miscellaneous group. By comparison of these cases to the gold standard of judgement by the clinician, the severity could be assessed. Subsequently, it would be interesting to know how many of these cases would have been missed in other studies on SAMM using other inclusion criteria. Initial rough analysis of the summary data of this group presented in chapter 3 reveals that many truly severe cases would have been missed. Of note, 35% of maternal deaths would have been missed without including a miscellaneous group.

Conclusion

The LEMMoN study has provided a valuable overview of SAMM in the Netherlands. Incidences of different types of maternal morbidity are now known and can serve as a reference for future assessment in the Netherlands and other countries. Trends in incidence should be monitored continuously, and further research is warranted to explain changing patterns and target interventions to reduce SAMM. Non-Western immigrants appeared to be at increased risk of developing SAMM, but risks were less pronounced than in maternal mortality. Especially sub-Saharan African woman appeared to be at risk. Audit of severe maternal morbidity is feasible and highly instructive. Continuous auditing of severe maternal morbidity is mandatory in view of the high rate of substandard care found during SAMM audit meetings: 80% of cases as compared to 25% for perinatal mortality. This indicates that women are paying a considerable price for the increased importance of the fetus as a patient.

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