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The face of salutogenesis: an interdisciplinary Swiss thermal imaging case report

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Abstract

Background. Health-oriented practice is advocated, since 'too much medicine' has led to increased health costs without an increase in health. Conversely, negative iatrogenic outcomes have been reported in both medicine and midwifery care. Recent research has described health-oriented midwifery practice, but little is known about how health-oriented practice can be measured.

Aim. This pilot study investigated whether infrared thermal imaging is able to distinguish between health-oriented and clinically-oriented practice. Building upon previous studies that distinguished specific thermal imaging patterns related to specific emotional states, this study attempted to record the specific thermal signatures relating to health-oriented and clinically-oriented practice. Thus it aimed to provide a quantitative definition of health-oriented practice in midwifery consulting sessions. This single case study is the first attempt to assess professionals' health orientation in maternity care.

Methods. For this initial purpose two midwives with differing professional orientations were required to enroll in the study. Following consent for participation, the consulting session of a health-oriented midwife was compared to the consulting session of a midwife with a clinical orientation. Both sessions were assessed using thermal imaging and voice recording.

Results. Two distinct profiles emerged from the descriptive analysis of the thermal images. While the health-oriented midwife showed significant changes in facial, neck and hand temperature, there were almost no changes in the thermal images taken of the clinically-oriented midwife, both in terms of temperature values and temperature diffusion.

Discussion/conclusion. These differences are assumed to be related to the professional orientation of the midwives. To examine these assumptions, further studies on larger samples are needed.

Key words: Salutogenesis, thermal imaging, thermal signature, midwife, health promotion, evidence-based midwifery

Introduction

Health orientation is claimed for both health promotion and medicine (Koelen and Lindström, 2016). Health-oriented practice has been defined in addition, and in contrast to the fact that 'too much medicine' has led to increased health costs but not to an increase in health (Miller et al, 2016). To the contrary, negative iatrogenic outcomes have been reported in medicine as well as in midwifery care as a consequence of a practice exclusively based on risk avoidance and clinical orientation (Miller et al, 2016; Sinclair and Stockdale, 2011). In recent years healthcare has moved towards a more health-promotion approach through the implementation of health-oriented practices in order to optimise results and minimise unnecessary interventions. In the field of midwifery specifically, approaches based on the theory of salutogenesis by Aaron Antonovsky (Antonovsky, 1987) have been strengthened to achieve optimal birth (Lindström et al, 2017; Sinclair and Stockdale, 2011; Downe, 2010).

Salutogenic theory and salutogenic research explore the question of 'What creates health?' and so complement the clinical research of pathogenesis, which focuses on the causes of illnesses and diseases. In salutogenic theory, health is conceptualised not as a state but as a process on the continuum between 'health-ease' and 'health-disease', as Antonovsky named the poles of health and disease (Antonovsky, 1987). Individuals move on this continuum in a life-long learning process of meeting demands and challenges in life. Health depends on the individual's resources and on their sense of coherence (SOC). SOC is 'a global orientation that expresses the extent to which one has a pervasive and enduring, though dynamic, feeling of confidence' (Antonovsky, 1987) that:

- Demands in life happen in an orderly and predictable way, and a person can understand events in life and reasonably predict what will happen in the future (sense of comprehensibility)
- One has the skills or ability, the support, the help, or the resources necessary to take care of demands, and that they are manageable (sense of manageability)
- Demands in life are interesting and a source of satisfaction, they are genuinely worthwhile and there is a good reason or purpose to care about what happens (sense of meaningfulness).

These three dimensions of SOC (comprehensibility, manageability and meaningfulness) are related and interact with each other. SOC is measured by the SOC scale, a validated questionnaire that has been translated and adopted

to allow studies for two-thirds of the world population in a native language (Lindström and Eriksson, 2010).

This scale has been has been widely researched. Strong evidence, based on a broad range of international longitudinal and controlled studies, shows that SOC is a predictor of lifelong psychological and physical health (Lindström and Eriksson, 2010). SOC can be understood as a measurable orientation which makes it possible to activate available resources for the maintenance of health and wellbeing, to protect oneself from health stresses, to overcome stressors and to achieve quality of life (Lindström and Eriksson, 2010). Thus, salutogenesis can be understood as a valuable theory underpinning health-oriented practice (Lindström and Eriksson, 2005).

Moreover, research has shown that an individual's SOC can be positively influenced, especially during the period of childbirth, which is a major event in a woman's life, carrying a high potential to influence their SOC levels. However, there is little research on whether and how a maternal SOC can be directly reinforced by their experiences during pregnancy, childbirth and the postpartum period (Lindström et al, 2017).

Since SOC has been shown to be a crucial determinant of health, it is important to identify how professionals' methods may strengthen SOC in individuals. Recently, in addition to Antonovsky's concept of the 'sense of coherence', a new concept, the 'sense for coherence' has been introduced (Lindström and Eriksson, 2010). This has been defined as the sense of professionals' to improve the 'sense of coherence' of the people they work with (Koelen and Lindström, 2016).

However, little is known about the nature of sense for coherence. It also remains unclear as to whether the salutogenic approach of the health professional can really 'radiate' positive energy or cause them to act differently towards the patient or the pregnant woman. Descriptive, qualitative analysis has been undertaken (Meier Magistretti et al, 2016) showing that elements of health-oriented practice described by midwives mirror SOC. There is as yet no quantitative evidence for this.

In light of this lack of evidence, this paper seeks to address the issue of whether it is possible to objectively and reliably describe and measure sense for coherence.

The hypothalamus, controlling the autonomic nervous system (ANS), directly regulates body temperatures as well as feelings of hunger and thirst. Emotional expressions and behaviour are regulated in a similar way by the higher centres of the brain through the ANS (Ioannou et al, 2014).

It has also been demonstrated that various emotions and behaviour are associated with variations in the temperature of particular areas of the body. Specifically, it has been shown that different behaviour causes different thermal reactions on the face, hands, and other body areas, releasing specific thermal signatures (O'Kane et al, 2004; Yoshiton et al, 1997).

Thermal imaging as a method has been used for several decades in the social sciences, psychophysiology and psychology, enabling researchers to recognise and distinguish emotions such as stress, anxiety, fear, anger and joy with accuracy of up to 90% (Ioannou et al, 2014; Ebisch et al, 2012; Nozawa and Tacano, 2009; Pollina, 2006; Levine et al, 2001; Shearn et al, 1990; Zajonc et al, 1989). Thermal imaging is easy to use, completely safe and non-invasive. It enables researchers to perform a variety of studies in the fields of healthcare and medicine (Topalidou and Downe, 2016; Ring and Ammer, 2000).

Aim

The aim of this pilot study was to investigate whether infrared thermal imaging is able to distinguish between health-oriented and clinically-oriented midwifery practice and identify the specific characteristics of each.

At the same time, efforts were made to visualise these differences, to record specific thermal signatures in order to provide a quantitative definition of salutogenic practice in action by evaluating thermal signatures numerically.

Method

Participants and recruitment

Two midwives, who were evaluated and classified based on their professional orientation as health-oriented (HO) and clinically-oriented (CO), were recruited for the study.

Their classification into one of these two categories was based upon their completion of a short questionnaire produced by one of the authors based on prior research on the health orientation of midwives (Meier Magistretti et al, 2016). This study had revealed three patterns of health orientation in midwives' tacit professional knowledge: explicit, implicit, and contrasting conceptualisations of health.

The first concerns health explicitly, characterising professional midwifery practice as part of health promotion and pointing at its relevance for the lifelong health of mothers, babies and families. In the second, implicit pattern, health is conceptualised implicitly, rather than in explicit health terms, by speaking of overarching concepts such as 'spiritual birth' or 'natural birth'. As a third pattern, health concepts in contradistinction to pathological concepts were found. In this pattern, midwives define health orientation in contrast to a pathologically or technically oriented practice (Meier Magistretti et al, 2016).

This study used short open questions on the philosophy of participants' professional orientation to identify their health or clinical orientation. Health orientation was assumed when the midwife answered in one of the patterns described before, clinical orientation when the midwife explicitly focused on risk avoidance and pathology.

Both participants had at least three years' experience as midwives and during the study were working at the same birth house. Participant exclusion criteria have been previously described in the literature (Topalidou and Downe, 2016).

Ethics

The participants (midwives) were provided with an information sheet and a written consent form two weeks prior to the start of the study. The participants were advised they could withdraw from the study at any time.

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To secure the privacy of consultation, the researcher who performed the thermal imaging was not a German speaker and the psychologist, who assessed the recordings after the session, did not know any personal details about the pregnant women involved. All data were saved with a serial number, and no personal identifiers were used. Pregnant women were also informed in detail about the procedure, their agreement was required and they were allowed to withdraw at anytime. They and their babies were not exposed to thermal imaging.

Technique and measurement procedure

All measurements were taken under stable environmental conditions with the temperature and humidity being constant at (20±1°C) and (50±2%) respectively. To avoid any disturbance in this environment a consistent number of people were in the room in which measurements were being taken during every evaluation (the researcher, the midwife, and the pregnant woman). This room was furnished with only the necessary furniture and equipment to allow the measurements to take place (Ring and Ammer, 2000).

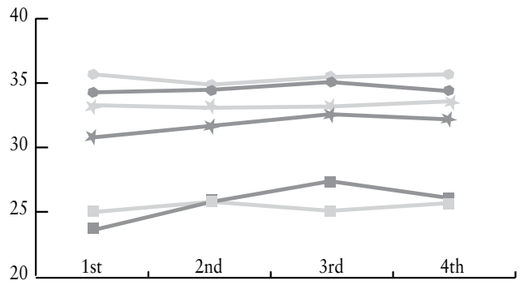
Thirty minutes before the measurement procedure, the participants were instructed to remove all their jewelry and any other material, such as scarves or other clothing from the region of interest (ROI) (face/neck/hands) to ensure equilibrium of the temperature of the skin. Participants were advised that hair should be tied up or tucked behind the ears so that it did not cover the ROI. After acclimatisation and before the beginning of consultation, the first set of images was taken (0 minutes – starting point SP). The next set of images was taken at 10 minutes, 20 minutes and then 30 minutes (end of consultation – end point EP). In total four measurements were taken for each participant. Each set of images consisted of three recordings: face and neck frontal view (FNF) and palmar (HP) and dorsal (HD) aspects of both hands (with fingers not in contact). For the recording of the hands, participants were asked to slightly raise their arms in front of their body. Time was counted with a digital timer with timing beginning after the first measurement. Ten seconds before each re-evaluation the participant was informed with a hand sign.

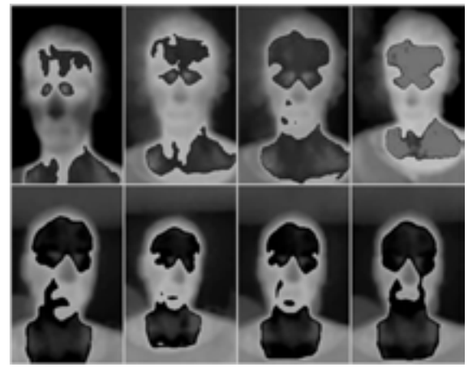
A FLIR C2 thermal camera was used for thermal imaging recording. The distance between the camera and the participant in every measurement was 1m (±0,1m). Human skin emissivity was set at 0.98. In order to protect participants' privacy and anonymity, the multi-spectral dynamic imaging (MSX), which ensures easier target and ROI identification and was used for analysis of the images, was excluded from the final display of the images. To measure the area of thermal distribution specific software was used.

Finally, to ensure and to re-assess the orientation of midwives (HO versus CO) the consultation was recorded with a digital voice recorder (Olympus VN-741PC). A psychologist specialising in salutogenesis listened to all the recordings to assess the orientation of the midwives. All consultations were in German. As this was a pilot study, only one consultation by each midwife was recorded.

Figure 1. Thermal signatures and their changes from the first measurement (SP) to the last (EP) are represented. The thermal signatures of the HO midwife (dark lines/upper images) and the CO midwife (light lines/lower images) are shown. For each assessment, the maximum, minimum and average temperature values of ROIs are presented

HEAD				
Max temp	34.4	34.6	35.2	34.5
Min temp	23.7	25.9	27.5	26.2
Average temp	30.9	31.8	32.7	32.3
Max temp	35.8	35.0	35.6	35.8
Min temp	25.1	25.9	25.2	25.8
Average temp	33.4	33.2	33.3	33.7





Results

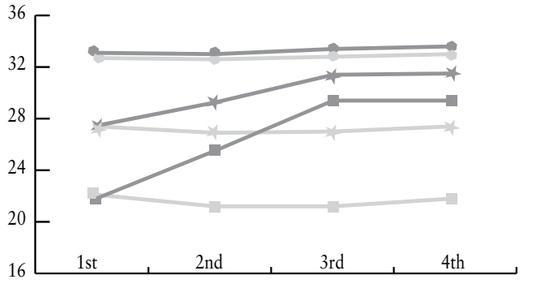
Thermal imaging was completed on the face, palmer and dorsal aspects of the hands to enable the reading of temperature signatures and distribution. A details analysis of each ROI was performed.

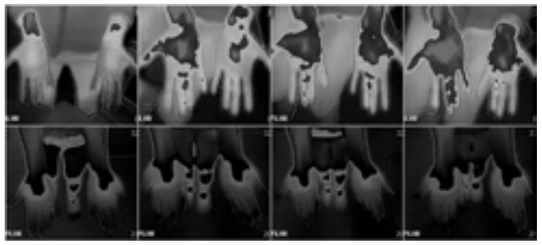
Face and neck

To analyse the results, the frontal bone of the skull including the superior and inferior palpebral sulcus, were defined as the facial ROI. Neck ROI included the anterior and lateral neck triangles, as they are described in surface anatomy

Figure 2. Thermal signatures and their changes from the first measurement (SP) to the last (EP) are represented. The thermal signatures of the HO midwife (dark lines/upper images) and the CO midwife (light lines/lower images) are shown. For each assessment, the maximum, minimum and average temperature values of ROIs are presented

HANDS PALMAR ASPECT				
Max temp	33.1	33.0	33.4	33.6
Min temp	21.8	25.5	29.4	29.4
Average temp	27.45	29.25	31.4	31.5
Max temp	32.7	32.6	32.8	33.0
Min temp	22.1	21.2	21.2	21.8
Average temp	27.4	26.9	27.0	27.4





(submental, submandibular, carotid, muscular, occipital and supraclavicular triangles) having as a lower border the two clavicle bones (see Figure 1).

Descriptive analysis of the thermal images demonstrated that the CO midwife showed almost no change in temperature values and diffusion while the HO midwife presented differences in both parameters, in facial and neck ROIs.

While the maximum temperature for both midwives did not show extreme changes during re-assessments and the EP measurements (HO 34.4°C and CO 35.8°C) were exactly the same as the SP measurements (HO 34.5°C and CO 35.8°C), they followed different patterns. The maximum temperature for the HO midwife gradually increased in the second (34.6°C) and third measurement (35.2°C) to return finally, at the EP assessment, to the baseline value (SP). The maximum temperature for the CO midwife was reduced in the second (35.0°C) and third measurement (35.6°C) to revert finally up to baseline levels (35.8°C). Significant differences were noted between the two midwives regarding the minimum temperature. While it remained approximately stable between 25.1°C to 25.9°C for the CO midwife, it increased significantly during re-assessments for the HO midwife. In the first recording of the HO midwife the minimum temperature was only 23.7°C, much lower than the corresponding value for the CO midwife. After, in the second and third measurement, it showed an increase of up to four units (27.5°C). It is worth noting that in the final recording (EP) the minimum temperature decreased slightly (26.2°C), reaching almost the same level of EP minimum temperature as that of the CO midwife (25.8°C). Based on these differences, the average temperature values varied between the participants, whereas they remained almost constant in all recordings for the CO midwife, they increased significantly for the HO midwife. All the values are presented in Figure 1.

Apart from the temperature values, significant differences were evident in the temperature diffusion. To set the temperature diffusion and to represent the thermal signatures (isotherm analysis), a personal minimum recording limit (MRL) for each participant was defined. The maximum value of all average values recorded was defined as MRL. Similarly, the MRLs for dorsal and palmar aspects of hands were set. As it was observed, for the CO midwife the temperature distribution in forehead and neck remained almost unchanged, covering almost entirely the ROIs (see Figure 1). Specifically, the thermal diffusion on the forehead started within an area of 24.07cm^2 in SP assessment. After 10 minutes it was 23.08cm^2, spreading to 24.64cm^2 in 20 minutes evaluation and at the EP recording it stayed at 24.64cm^2 (relative values).

In contrast, for the HO midwife there was a significant difference between the first and second measurement, mainly in the area of the procerus muscle. In the third recording, at 20 minutes, almost the entire area of the forehead and the neck had been covered, surpassing in size the corresponding area of the CO midwife. After this extreme increase in the third measurement, the diffusing area decreased again in the last recording (see Figure 1). In particular, in the first recording the thermal diffusion area of the forehead of HO midwife was only 9.77cm^2 and increased to 15.27cm^2 in the second assessment. During the recording at 20 minutes the area was 38.41cm^2, and at EP assessment the area had slightly decreased to 21.02cm^2 (relative values).

Palmar aspects of hands

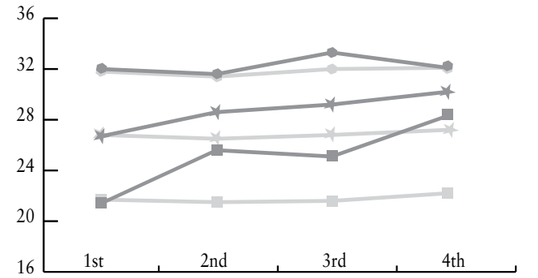
Similar to the facial area, the CO midwife did not show any significant differences in the hands. Temperature values (maximum, minimum and average) and the thermal diffusion remained remarkably stable. In contrast, for the HO midwife no significant changes were evident in the maximum temperature. However, the minimum temperature increased significantly by nearly four points between the first (21.8°C), second (25.5°C) and third (29.4°C) measurement to stabilising at 29.4°C in the EP assessment. This change in the minimum temperature resulted in similar alteration of average temperature. At the same time, it is worth mentioning the significant change of thermal diffusion on both palms of the HO midwife (see Figure 2).

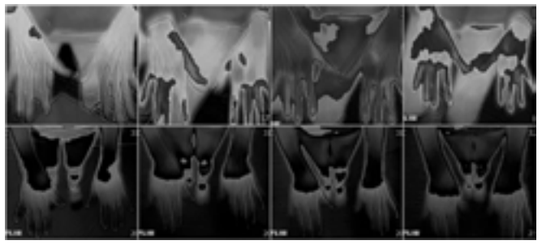
Dorsal aspects of hands

The temperature values and thermal diffusion in the dorsal aspects of hands remained almost constant for the CO midwife. The maximum temperature for the HO midwife showed a slight increase in the third recording, where the largest area of thermal diffusion appeared. This significant diffusion may also be related to the increase of the minimum temperature. However, the minimum temperature displayed the maximum increase in the second assessment (25.6°C) in comparison with the first (21.4°C) and remained almost stable in the third (25.1°C), to increase again at 30 minutes (28.3°C) (see Figure 3).

Figure 3. Thermal signatures and their changes from the first measurement (SP) to the last (EP) are represented. The thermal signatures of the HO midwife (dark lines/upper images) and the CO midwife (light lines/lower images) are shown. For each assessment, the maximum, minimum and average temperature values of ROIs are presented

HANDS DORSAL ASPECT				
Max temp	32.0	31.6	33.3	32.1
Min temp	21.4	25.6	25.1	28.3
Average temp	26.7	28.6	29.2	30.2
Max temp	31.8	31.4	32.0	32.1
Min temp	21.7	21.5	21.6	22.2
Average temp	26.8	26.5	26.8	27.2





Discussion

In recent years, there has been an increasing request for health orientation in maternity care and therefore a deeper understanding of this phenomenon. Existing studies of the nature of the professional health orientation have been predominantly qualitative research (Meier Magistretti et al, 2016). However, the need to change from the clinical or pathologic assessment of health to a more asset-oriented approach has been clearly described, based on the salutogenic theory by Aaron Antonovsky (Lindström et al, 2017; Sinclair and Stockdale, 2011; Downe, 2010). Still, an in-depth understanding, differentiation, and objective determination of salutogenesis in practice is needed (Dietscher et al, 2017; Eriksson and Lindström, 2006; 2005).

The purpose of this pilot study was to investigate whether thermal imaging, as a non-invasive and ecological method, could give an 'image' that could possibly be developed to provide evidence of what a salutogenic health-oriented approach might consist of.

The heat emitted by the human body can provide substantial physiological as well as psychological information about individuals (Topalidou and Downe, 2016; Ioannou et al, 2014; Ebisch et al, 2012; Ring and Ammer, 2000). In terms of future research, while the sample size is extremely small, the results of this pilot study are potentially significant. Essentially, in the CO midwife facial and hands temperatures did not change throughout the session with the pregnant woman, which could be described as a psycho-emotional plateau. In the HO midwife, the temperatures of both the face and the hands showed considerable fluctuations (see Figures 1, 2 and 3). To determine what caused these fluctuations, further investigation is required, using a larger sample and more variables.

Also significant is the temperature diffusion on the face and dorsal aspects of hands (see Figures 1 and 2), both of which follow a similar pattern. In the HO midwife, within 20 minutes of the start (third recording), the body temperature that is above the maximum average appears in almost all of the ROIs, while in the CO midwife there is almost no change from the beginning to the end of the session. A slightly different pattern was observed in the palmar aspect of the participants hands, where the biggest diffusion area displayed in the last recording (end of the session) for the HO midwife (see Figure 3). In addition, it is worth mentioning that for the dorsal and palmar aspect of both midwives' hands, all temperature values (maximum, minimum, average) in the first recording were almost equal (see Figures 2 and 3). While they were two different individuals, the temperature values at the beginning of the session were almost the same, and then the deviation was observed, with the increasing values for the HO midwife and the stable values for CO.

It is difficult to determine what caused these results as the present study is the first trial to provide a visual

representation to a health-oriented approach in practice, paving the way for further studies. One biological explanation for the observed temperature differences could be that it is secondary to vasodilation caused by production of oxytocin in the midwife who was assessed as having an empathic salutogenic orientation. However, a one-off study of only two cases is highly subject to bias, therefore funding has been obtained to test the findings with a larger sample in future research, to provide a clearer picture of the 'face of salutogenesis'.

Conclusion

Childbirth is crucially important for lifelong health of mothers, babies and their families. This study focuses on midwives' health-oriented professional practice that is assumed to be beneficially influencing important determinants of health, such as the SOC as it has been described in the theory of salutogenesis. So far, analysis of health-promoting midwifery practice has been limited to qualitative studies and quantitative methods of measurement were lacking. This study finds that thermal imaging can be used to describe physiological processes: two patterns can clearly be seen that relate to the different practices midwives have in consulting sessions.

These differences are assumed to be related to the professional orientation of the midwives that can be described as either health-oriented or clinically-oriented. To examine these assumptions, further studies using larger samples are needed. The differences demonstrated in this study need further investigation in order to ascertain if they occur systematically, if they can be related to health orientation or if factors such as emotional involvement, empathy or relationship quality are involved and what role they may play.

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