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# **ERGONOMIC DESIGN OF A PHYSIOLOGIC BIRTH-SUPPORT SYSTEM**

**A Research Thesis  
for the Fulfilment of the Degree of  
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by  
BOI LEONG YAP**

**MASSEY UNIVERSITY  
NEW ZEALAND**

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## ABSTRACT

The main theme of this study is centred on the design and evaluation of an Obstetric Body-Support System for upright childbirth that is physiologic and biomechanically efficient, besides improving the tasks of the birth attendant in the management of labour and promoting the safety and well-being of the mother and her baby.

Current practices in obstetrics and consumers' expectations are not congruent. Childbirth - a physiological event is increasingly being managed as a pathological process under medical and surgical frameworks. Medicalisation has increased iatrogenic risks to both mothers and babies and is causing profound concerns.

The last two decades have witnessed two major developments in maternity care moving in opposite directions - the growing dependence on obstetric technology and the increasing demand for natural birth and humanised maternity care. Consumers' demands are no longer based simply on the emotive needs for change. They are based on recent research evidence that is indicating that less technological interference in childbirth is better than more.

The posture adopted by the mother during labour is considered to be the most important factor for the safe passage of the foetus through the birth canal. There is Biblical and historical evidence that the natural posture adopted by women during childbirth has always been in some form of the upright position - sitting, squatting, kneeling and standing. The supine position for delivery facilitates the management of labour, but it has no established benefit for the maternal mother and the foetus. Many physiological disadvantages that adversely affect maternal well-being and foetal oxygenation are associated with the supine position.

In contrast, the upright posture for childbirth has been found to be more beneficial to the mother and foetus. The advantages of the upright posture for labour include: taking advantage of gravitational forces to promote foetal descent; preventing compression of the aorta, inferior vena cava and umbilical cord; increasing the size of the pelvic inlet; promoting more effective bearing-down effort and promoting more efficient contraction. In terms of psychological responses, labouring in the seated position has been found to promote active participation, control and emotional satisfaction.

This study examined some of these issues from an ergonomic perspective for the design and evaluation of an Obstetric Body-Support System that is compatible with the physiology of childbirth and the management of labour in current hospital settings. Antenatal and postnatal user trials were conducted to evaluate the new Obstetric Body-Support System. Responses from birth attendants and childbearing women for the new System were both positive and encouraging, indicating acceptance, system compatibility and design viability.

The changing trend in childbirth demands solutions that are difficult to find in traditional maternity care and practice. The answer is in natural birth - where the woman's enormous psychological, physiological and biomechanical capabilities are relied upon to give birth spontaneously - without technological intervention.

Ergodesign - a new hybrid interdisciplinary technology was conceived to design and evaluate the Obstetric Body-Support System that supports and facilitates natural childbirth in the upright position. It is argued that the use of ergonomics and design as separate disciplines militates cohesive design thinking and the creative processes. Besides the symbiotic aspects of ergodesign, the truly interdisciplinary attributes become an effective and synergistic design tool, that is more powerful than conventional approaches of applying ergonomics and design as separate disciplines.

The ergodesigner as a scientist, designer as well as a change-agent played a vital role in solving the intricate human-equipment-environmental problems in the management of labour and childbirth in hospital systems. The application of ergonomics to improve childbirth is a complex task, requiring full participation from childbearing women, midwives and obstetricians. They contributed significantly by enlightening the ergodesigner with an "insight" surrounding labour and childbirth, and were involved in the development of body-support concepts, appraisals of mock-ups and evaluations of the prototype Obstetric Body-Support System.

A programme of further work is planned to evaluate the clinical aspects of the maternal woman and the baby before conclusion can be drawn on the safety of the new Obstetric Body-Support System.

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## GLOSSARY

**Anaesthesia:** Loss of feeling or sensation. General anaesthesia implies not only a loss of feeling or sensation but also of consciousness and memory. Regional anaesthesia implies a loss of feeling or sensation in a restricted area of the body.

**Analgesics:** Painkilling agents not inducing unconsciousness.

**Anthropometry:** The science of measurement of the human body to determine differences in groups, individuals, etc.

**Apgar Score:** A general test of the baby's wellbeing given immediately after birth to ascertain the heart rate and the tone, respiration, blood circulation and nerve responses.

**Asphyxia:** Suffocation; state of decreased oxygen and increased carbon dioxide in blood and tissues.

**Biomechanics:** The application of the principles and techniques of mechanics to the structure, functions and capabilities of the human body.

**Bonding:** The spontaneous formation of attachment between mothers and their babies in the period immediately following birth.

**Caesarean section:** Delivery of the baby by surgery, through an incision in the mother's abdomen and uterus.

**Cephalopelvic disproportion:** A situation in which the head of the unborn baby is too large to pass through the pelvic bones of the mother.



**Cervix:** The lower end of the uterus, or neck of the womb.

**Concept:** An idea or impression of a design or theory.

**Contraction:** The regular tightening of the uterine muscles as they work to dilate the cervix in labour and to press the baby down the birth canal.

**Demoral:** A frequently used analgesic in hospital delivery.

**Design:** To analyse and devise a form that serves a particular purpose.

**Discipline:** A branch of knowledge, field of study or specialty subject.

**Dystocia:** Slow or prolonged or difficult labour.

**Epidural anaesthesia:** A regional anaesthesia in which a local anaesthetic agent is injected into the epidural space of the spine.

**Episiotomy:** A surgical incision into the perineum to enlarge the vagina opening to speed the birth of the baby. Also known as the "unkindest cut".

**Electronic-foetal monitoring:** The continuous monitoring of the foetal's heart by a transducer placed on the mother's abdomen over the area of the foetal heart, or an electrode inserted through the cervix and clipped to the baby's scalp.

**Ergodesign:** An integrated ergonomics and design approach used in equipment and system design.

**Ergonomics:** A technology that seeks to improve mental and physical well-being by optimising the function of human-machine-environment systems.

**Evaluation:** Appraisal or test to ascertain the "fit", usability, safety, etc of a piece of equipment or system.

**Fontanel, fontanelle:** Spaces in the skull of the foetus and young infant where the skull bones have not yet grown together.

**Forceps:** An instrument with two blades and handles for forcibly pulling the foetus, by the head, through the birth canal.

**Haemorrhage:** Excessive bleeding.

**Iatrogenic:** Produced or caused by a physician.

**Interface:** The point of contact between the human being and the equipment.

**Intervention:** In obstetrics, an invasive procedure that literally intervenes or interferes with the natural process of birth. The term denotes active interference and implies meddling with Mother Nature.

**Ischial Tuberosity:** The rounded portion of the bone of the pelvis on which the body rests when sitting.

**Kinetosphere:** A large cubical structure used for the study and measurement of the biospace or work-envelope.

**Labour:** Contraction of the uterus resulting in the birth of a baby.

**Lacerations:** A tear in the perineum.

**Lamaze Method:** A set of techniques, including complex breathing patterns, devised by Fernand Lamaze, as an alternative to drugs in reducing a woman's awareness of pain in labour.

**Lithotomy position:** Horizontal, supine or recumbent position. A woman giving birth in this position is flat on her back with legs spread in stirrups.

**Low-risk pregnancy:** The probability that pregnancy and childbirth will be uncomplicated or normal.

**Mock-up:** A full-size model of equipment for research, study or testing.

**Multigravida:** A woman in her second or subsequent pregnancy.

**Multipara:** A woman who has given birth to more than one child.

**Multiparous:** Bearing or having borne more than one child.

**Optimisation:** An effort to achieve the best system outcome.

**Oxytocin:** A drug that causes the uterus to contract. As a uterine stimulant, it is used to induce labour or to accelerate existing labour.

**Parturient:** A woman in the process of giving birth. Giving birth; pertaining to birth.

**Perineum:** The area surrounding the vagina and between the vagina and the rectum.

**Phenomenon:** Any sensations that can be perceived by the senses.

**Placenta:** The organ which develops on the inner wall of the uterus and supplies the foetus with its life-supporting requirements and carries waste products to the mother's system.

**Postpartum:** After the delivery or following childbirth.

**Primipara:** A woman who has given birth to one child.

**Primiporous:** Bearing or having borne only one child.

**Primigravida:** A woman having her first pregnancy.

**Prototype:** An original model from which other improved models can be made.

**Psychoprophylaxis:** A method of preparation for natural birth.

**Sedentary Anthropometer:** A device used for the study and measurement of the sitting postures.

**Sociotechnical System:** A system approach that takes into account and optimises both the social sub-system and the technical sub-system.

**Symbiosis:** A close association between two interdependent subjects.

**Synergy:** Efficiency achieved by a combined action.

**System:** A group or combination of interrelated, interdependent or interacting elements forming a collective entity.

**Uterus:** The sac of muscle in which the foetus develops and that contracts during labour to push the foetus out; also called "womb".

**Vacuum extractor:** A suction device affixed to the unborn baby's head to pull the baby out.

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