Thesis Abstract: Air Movement in the Human Sleeping Environment and Sudden Infant Death

JOHN ANDREW CORBYN

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Searches for disease or abnormality within the infant have not led to an explanation for many Sudden Infant Death Syndrome or SIDS cases. The present study considers SIDS in terms of the microclimate at the face and the inhalation of previously exhaled air. Inhalation of previously exhaled air is also known as re-breathing. The physiology of sleeping in re-breathing conditions and SIDS is discussed. Statistical data concerning SIDS and environmental conditions is reviewed.

The transport of carbon dioxide from and oxygen to the face is effected by jet action of the nose and other processes. Temperature, humidity, pollution (which affects aerosol formation), bedding arrangement, sleeping position and other conditions are significant. A simulator for studying sleeping environments is described. It was found that exhaled air can accumulate at the face of a sleeping infant. In some circumstances the carbon dioxide content of the inhaled air is above the industrial threshold limit of 0.5% with values of over 2% occurring.

Physiological mechanisms exist which allow that re-breathing of vitiated air can account for a proportion of SIDS cases. In particular a sleeping infant acclimatized to an atmosphere with excess carbon dioxide may suffer from a reduced lung ventilation rate [in medical terms a reduced minute volume] on subsequent exposure to a normal atmosphere.

The associations between SIDS and particular environmental conditions were found to be consistent with re-breathing as a cause of SIDS. It is recommended that sleeping infants have unobstructed passage of exhaled air away from the face. Detailed safety precautions are given. It is clear that investigations of SIDS deaths should include physical model studies of the infant’s sleeping environment; follow-up SIDS investigations should include searches for evidence of past exposure to continual re-breathing.

Dr J.A. Corbyn
Department of Mining Engineering
University of Technology
LAE Papua New Guinea

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Sudden Infant Death, Crib Death (U. S. A. term for cot death), Cot Death and Overlaying (where baby dies in bed with mother) and now all described as SIDS, have been found to be more common in these circumstances: winter, low temperatures, high humidity, atmospheric pollution.

Explanation for a proportion of these deaths can be made in terms of the accumulation of exhaled air with excess carbon dioxide at the face during sleep. The result of continued sleeping in this environment is that the infant becomes acclimatized to a high carbon dioxide level in inspired air and the control of breathing becomes abnormal. Exhaled air from other persons or animals sleeping close to the face of the infant may also contribute.

POSSIBLE DANGER

SAFE

Breath carried away from face by nose

Conditions that make the retention of exhaled air in the bed more likely:

* Soft bedding
* Bulky bedding near the face
* No draughts
* Face down position
* Damp or wet bedding
* Confined cot, pram or bed
* Unventilated mattress
* Infant under bedding
* High humidity (see note A)
* Tobacco smoke, air pollution
* Exhaled air directed into bed

Conditions that make retention of exhaled air near the face less likely:

* Hard bed
* Thin bedding
* Dry bed
* Face up position
* Draughts
* No bottles, toys or obstructions
* Not sleeping through the night
* Not exposed to breath of others (note B)
* Not sleeping between adults
* Not to sleep against a wall
* Mattress bedding not permeable
* Breath to direct air away from the face.

Note A: High humidity can result from climatic influences, unflued gas or kerosene heaters and evaporative air conditioners.

Note B: If in bed with adults the infant must not be down in the bed and exposed to a pool of exhaled air from the adults.

Always make sure that there is a clear space around the head so that the baby has access to fresh air. The breath coming from the mouth or nose is not obstructed so that it can move freely away from the face. Making sure that the baby gets fresh air will provide protection against the dangers of exhaled air at the face even if other conditions are bad.

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