

Aeration and Ventilation Properties of Five "Safe" Mattresses for Infants

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Background

• **Sudden infant death syndrome (SIDS)** is still a **leading cause of death** for infants aged one month to one year in developed countries.

• The **increased risk of SIDS** in at-risk infants (prone sleep position, covered by a blanket during sleep or placed on soft bedding) may be explained by **rebreathing of exhaled CO₂** which is confined to a small unventilated area near a sleeping infant's airway.

• Use of a **fan** during sleep **decreases the risk of SIDS by 72%**:

"...**increasing room ventilation by using a fan helps to disperse accumulated CO₂ in the dead air space around the nose and mouth of infants in sleeping environments that**

heighten the risk of rebreathing." *Arch Pediatr Adolesc Med. 2008;162:963-968*

• Products that **prevent rebreathing** of exhaled CO₂ **may benefit at risk infants** such as those who are placed or spontaneously prone for sleep, covered by a blanket or breathing from an unventilated air pocket.

Objective

To evaluate the aeration and ventilation properties of one standard infant mattress and five infant mattresses, which are marketed to prevent prone rebreathing.

Methods

• **A head box** which was placed with its open face on the mattress and connected with tubing to a gas reservoir filled with 7% CO₂.

• **A 60 cc syringe** with two one-way valves which simulates infant breathing.

• **A CO₂ analyzer** placed in the head box.

• **The sleep surfaces** studied included AirNetress® with (A+) and without (A) a fenestrated sheet, one standard infant mattress (F) and 4 additional infant mattresses (B-E) marketed as decreasing the risk for SIDS

Mattresses

A - AirNetress® - Meshed polyester netting stretched over a frame with an open area of approximately 50%

A+ - AirNetress® + fenestrated sheet

B - Aminach Air® - Foamed polyurethane with a 5 m"m honeycombed polyester upper surface

C - Aerosleep® - 5 m"m polyester honeycombed surface placed on a standard foam mattress

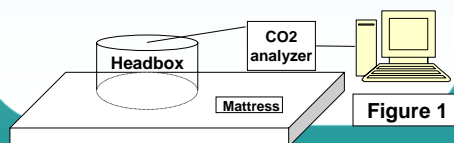
D - Baby Shilav 3000® - Foamed polyurethane with a three layered polyester coating.

E - Polyron Diamond® - Polyurethane covered with "three dimensional" cloth (3D)

F - Pang® - Standard infant foam mattress (foamed polyurethane) with a one layered polyester coating.

CO₂ elimination – static diffusion

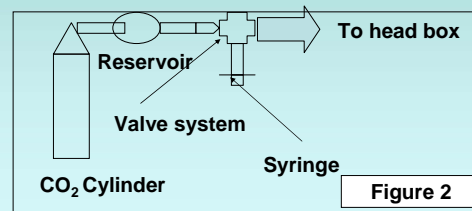
An air mixture containing 7% CO₂ was flushed into the head box. Once stable CO₂ levels were achieved, the head box was allowed to statically diffuse through the mattress. CO₂ concentrations were continuously measured. (Tab. 1 and Fig. 3)



Methods (cont.)

CO₂ accumulation-dynamic diffusion

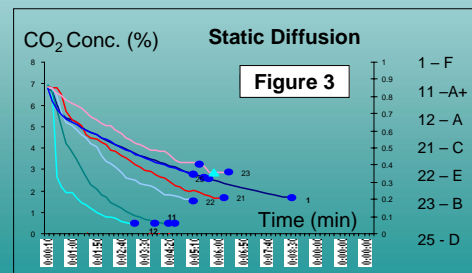
CO₂ was pumped at a concentration of 7% with a syringe, at a rate of 30/min and a stroke volume of 60 cc, simulating infant breathing. CO₂ concentrations were continuously measured until steady state levels were observed (Tab. 2, Fig. 4).



Results

Table 1. CO₂ (%) elimination - static diffusion

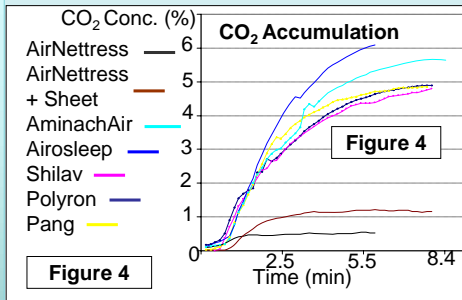
Time	A	A+	B	C	D	E	F
00:10.0	6.7	7	6.9	6.8	6.8	6.8	6.8
00:30.0	6.9	3.7	6.5	6.8	5.8	6.5	6
01:00.0	6.7	2.5	6.1	5.3	5.2	5	5.3
01:30.0	1.9	1.7	5.7	4.6	4.8	4.5	4.8
02:00.0	1.5	1.2	5.2	4.3	4.5	3.6	4.5
02:30.0	1	0.8	4.8	3.9	4.1	3.1	4.2
03:00.0	0.8	0.6	4.4	3.4	3.8	2.6	3.8



Results (cont.)

Table 2. CO₂ accumulation during infant breathing simulation (CO₂ conc.-%)

Time (min)	A	A+	B	C	D	E	F
10:00	0.1	0	0.12	0.13	0	0.17	0.03
1:00	0.1	0.1	0.16	0.23	0.38	0.25	0.07
1:30	0.3	0.5	0.36	0.44	1.31	0.91	0.42
2:00	0.4	0.7	1.4	1.48	1.94	1.69	1.36
2:30	0.5	0.9	2.26	2.53	2.43	2.32	2.26
3:00	0.5	1	2.88	3.44	2.84	2.65	3.17
3:30	0.5	1.1	3.2	4.16	3.29	3	3.47
4:00	0.5	1.2	3.66	4.52	3.57	3.41	3.85
4:30	0.5	1.1	4.27	4.98	3.86	3.76	4.11
5:00	0.5	1.2	4.67	5.4	4.06	4.06	4.31
5:30	0.5	1.2	4.9	5.67	4.28	4.26	4.49
6:00	0.5	1.2	5.11	5.89	4.37	4.46	4.57
6:30	0.5	1.2	5.28	6.05	4.44	4.59	4.68



Conclusions

AirNetress® has the following qualities:

- A fast rate of CO₂ elimination
- The ability to prevent CO₂ accumulation, keeping the maximal attainable CO₂ level below 1.2%
- These qualities significantly surpass those tested in all other mattresses