Baby Ergonomics Report

Ergonomics strives to improve the interaction between users and products, concerning effectivity, efficiency, safety, health and comfort.

2026, year 3, nr. 1

A pram cot is not a carrycot, cradle or crib

And they should not be combined in one product.

Perambulator cots and (carry)cots, cribs and cradles have approximately the same dimensions and are both intended for a child to lie down and rest or sleep. So there is a similarity. A perambulator cot or pram cot is for outdoor use. Some parents want to use a pram cot also indoors, as a carrycot or even as a crib or a cradle. This is efficient: two functions in one product saves costs and storage space. Some manufacturers claim that their pram cots can be used as a carrycot or cradle to sleep indoors.

But a pram cot on a stroller base for outdoor use is a different product from a crib, cradle, Moses basket or carrycot used indoors. Combining indoor and outdoor function in one product results in a suboptimal product that can compromise child health, safety and comfort. Why is it important to have two separate products instead of marketing a pram cot as suitable for indoor use?

Different environments

A pram cot and a cradle are used in different environments:

A pram cot is for use outdoors in the open air, with large temperature differences (± -15°C to +40°C), possibly with wind, rain and/or hail, plus other external factors such as dogs walking by or people diving into the pram, uninvitedly touching the baby. Daily usage time is often limited, except in cultures where babies are put to sleep outside in their perambulator for a large part of the day.

A carrycot, Moses basket, cradle and crib are used indoors, with temperatures usually 18 - 25°C, no wind, few other external factors, and often daily long-term use.

The environment determines some of the requirements for the product.

Protection is important outside

Outdoors, protection is much more important than indoors. Out in the open air the child must be protected against the wind, the cold (in most climates) and external elements. The base and sides of the cradle should therefore not ventilate. Sufficiently high sides without ventilation openings and with a hood against sun, wind and rain (and dogs and pushy people) are therefore important. Because of the natural air flow in the open air, there will be sufficient air circulation in the pram cot without openings in the sides.

For practical reasons, the width of a pram body is limited, to enable the perambulator to pass through doors. The child will then have little room to move. That is not a problem when going for a short stroll, but not comfortable nor healthy with long-term or frequent use.

Air circulation is important inside

Indoors, air circulation is limited. Sufficient air circulation in and around the cradle is very important for babies. Not only for oxygen supply but especially to prevent the accumulation of carbon dioxide (CO_2). Carbon dioxide gas is exhaled with expiration. As it is heavier than oxygen, it will accumulate at the bottom of a closed environment such as a pram cot. Inhaling too much CO_2 is harmful, see Jacobsen et al. (2019). Evidence indicates potential health risks at CO_2 levels as low as 0.1%, a threshold that is already exceeded in many indoor environments with increased room occupancy and reduced building ventilation rates. CO_2 concentrations exceeding 5% cause abnormally high CO_2 levels in the blood and a drop in blood pH. This can have various adverse health effects.

An indoor cradle should therefore promote air exchange between inside and outside by sufficient openings in the sides. Also, the base of the cradle must be well ventilated to prevent formation of mould.

Conflicting requirements

The requirements for a pram cot conflict with those for an indoor cradle. It is impossible to combine all these requirements into a single product.

Therefore a clear distinction should be made between the design and use of a pram body and the design and use of an indoor carrycot.



Figure 1. A pram cot suitable for outdoor use.



Figure 2. A carrycot suitable for indoor use.

Consumers need to be informed that a pram body is for outdoor use and a carrycot is for indoor use. The reason why this is important should be explained, too.

A warning in the instructions not to use a pram body indoors is warranted.

Never pamper a baby!

To every location for babies, the safe sleeping rules apply, amongst which: NEVER use soft, padded or fluffy sides, mattresses or cushions. This increases the chance on cot death, as stated in the Safe Sleeping Rules of many countries.

The trend these days is 'everything soft and fluffy'. It feels natural to pamper babies in padded materials that are soft to the touch. This is probably why parents go for soft, padded materials in a cot, a pram body and other baby products.

But these padded environments are unhealthy. Unpadded sides (open for a crib, closed for a pram) are most healthy and in the best interest of the child. Even though soft padded sides are the trend these days. Break this trend to make pram cots healthier.

Literature

Jacobson, T.A., Kler, J.S., Hernke, M.T., Braun, R.K., Meyer, K.C. and Funk, W.E., 2019. Direct human health risks of increased atmospheric carbon dioxide. *Nature Sustainability* 2, pp. 691–701.

Patel et al., 2001. Inspired CO_2 and O_2 in sleeping infants rebreathing from bedding- relevance for sudden infant death syndrome. *Journal of Applied Physiology*, 91, pp. 2537–2545.

Different requirements to pram cots and carrycots

A product in which a baby is placed indoors must ensure adequate ventilation and provide more than sufficient space for movement.

A product in which a baby is placed outdoors must protect the child against weather conditions and external influences.

Any product in which a baby can rest must always comply with Safe Sleep guidelines: it must have a firm, flat, and horizontal surface without soft bedding, padding or cushions.

It is paramount to inform consumers about this in all communication with customers in words and images.

Beware of vibrations!

Vibrations during transport affect babies far more than expected

Abstract. What kind of vibration loads do babies receive when transported in strollers and cargo bikes? A literature research was carried out and a practical research using dummies representing newborns and children aged 3 and 9 months, in five strollers and two cargo bikes on various road surfaces and —for the cargo bikes— two different speeds and two different seats.

Both in literature and in the practical research, vibrations were higher than expected. The most important factors affecting the vibrations are vehicle speed and road surface. The measured vibrations often exceeded the adult vibration limits for comfort and health. Although very little information regarding the effect of vibration on babies could be found, caution is warranted. Awareness of vibration levels is important and a high vibration load should be prevented. More research on the effect of transport vibrations on babies is necessary.

Introduction

The Dutch consumer safety organisation VeiligheidNL wished to know about the amount of vibrations received by babies transported in strollers and cargo bikes, and what the possible health effects are. They asked the Child Vibration Research Team (Delft University and Daams Ergonomie) to investigate. The purpose of the research was to improve the advice given to parents regarding baby transport.

The research consisted of a literature research on vibrations occurring during the transport of babies, and a practical research with five different strollers and two cargo bikes.

Method

1. Literature research on vibrations during the transport of babies.

2. Practical research to measure vibrations, using seat-attached accelerometers, on five strollers and two cargo bikes, carrying dummies representing infants of 0, 3 and 9 months, on various road surfaces, from asphalt to cobblestones and thresholds, at different speeds.

Results of literature research

Little is known about the effects of vibrations on children, but experts generally recommend minimising the amount of vibration that children are subjected to. There are no vibration standards for children; the only existing standard (ISO 2631-1) is for adults. Long-term vibration loads can cause various, sometimes serious, health problems in adults.

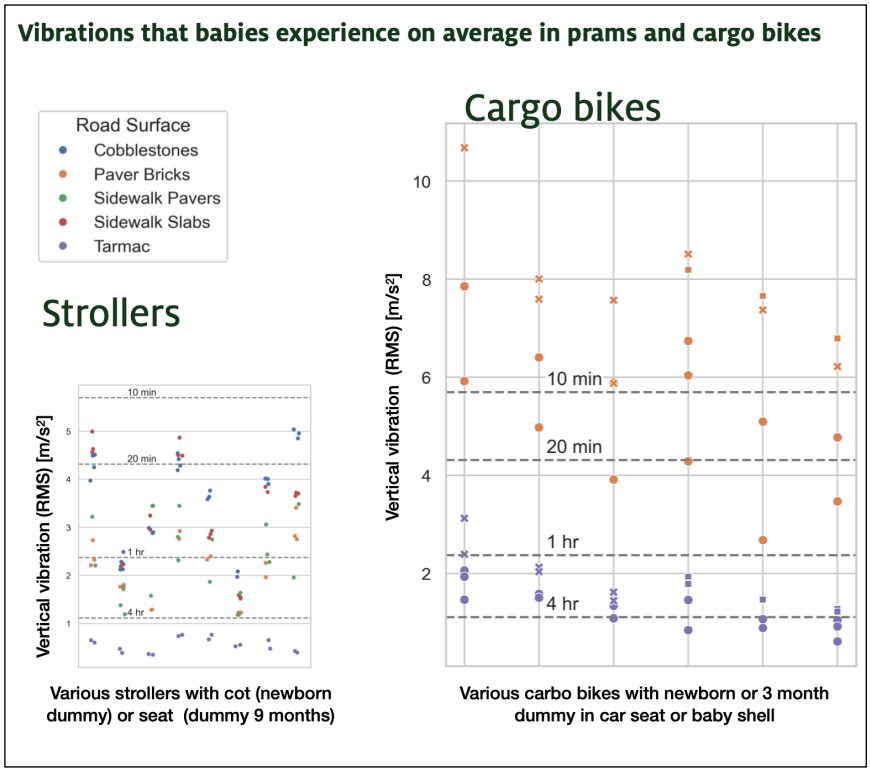


Figure 3. Average vibration loads experienced by babies transported in prams and cargo bikes.

The average vibration load for babies of different ages (0, 3 and 9 months) in 5 prams (graph left) and 2 cargo bikes (graph right), over 6 road surfaces (see legend). The dotted lines in the graph indicate the maximum duration that adults in a work situation may undergo the indicated vibrations according to the ISO 2631-1 standard for long-time daily exposure. Note that the limit values of 1 hour and less according to the standard are extrapolated from data. Above these limit values, health damage may occur in adults.

The comparison in the table only shows what the consequences would be for adults if they experienced the same vibrations as the babies in this study for extended periods on a daily basis.

The ISO 2631-1 standard is not validated for babies and children. Research is urgently needed to validate this standard and to adjust it for babies and children.

In baby car seats, bicycle seats, bicycle trailers, prams and transport incubators, children are subject to vibrations that according to the adult standard would often be classed from 'uncomfortable' and 'unhealthy' to 'extremely uncomfortable' and 'very unhealthy').

Watch the videos of the study:

https://bit.ly/strollervibration
https://bit.ly/cargobikevibration

Results of practical research

On asphalt the vibrations are limited, but the vibrations that children are subject to when being transported over cobbles, clinker bricks and pavements are such that the exposure time should be kept to a minimum. The faster the transport, the higher the vibration load.

Conclusion

The high vibration load that babies may be subjected to during transport gives reason for caution.

The effects of vibrations on the health of babies are unknown and should be investigated.

Advice is presented on how parents may limit the exposure of their children to vibrations during transport and thus mitigate possible negative health effects.

Advice for parents

- *Go slowly.*
- *Choose a route with a smooth surface.*
- *Reduce your speed on any surface rougher than asphalt.*
- *Use a large-wheeled stroller.*
- *Use a stroller with proper suspension.*
- *Limit the time the child is exposed to vibrations.*
- *When riding a cargo bike, limit your speed to 12 km/h.*
- *Limit cargo bike travel times over surfaces rougher than asphalt to 10 minutes.*

Advice for designers, producers, marketing and sales

- *Make consumers aware that high vibration loads for babies should be avoided.*
- *Add the above advice for parents to the instructions for strollers and cargo bikes.*
- *When designing a baby transport product, pay attention to proper suspension in order to reduce the resulting vibration load.*
- *Support the introduction of requirements regarding vibration and suspension into the EN 1888 standards for strollers.*

Designing for vibration is not easy. A suspension that is too soft can increase vibration instead of dampening it. The human vibration team is available for questions and consultancy. Contact Brecht Daams (daams@ergonomie) for more information.

Literature

Daams, B.J., Moore, J.K., Loeve, A.J., Papaioannou, G. en Happee, R., 2025. Literature research on vibration of children during transport. Report for VeiligheidNL, 31 January 2025.

Dell'Orto, G., Daams, B., Happee, R., Papaioannou, G., Loeve, A.J., Meijerink, J., Valk, T. and Moore, J.K., 2026. Vibration characterisation of strollers and cargo bicycles for transporting infants over different road surfaces. *Ergonomics*, https://doi.org/10.1080/00140139.2026.2642987

Baby carriers

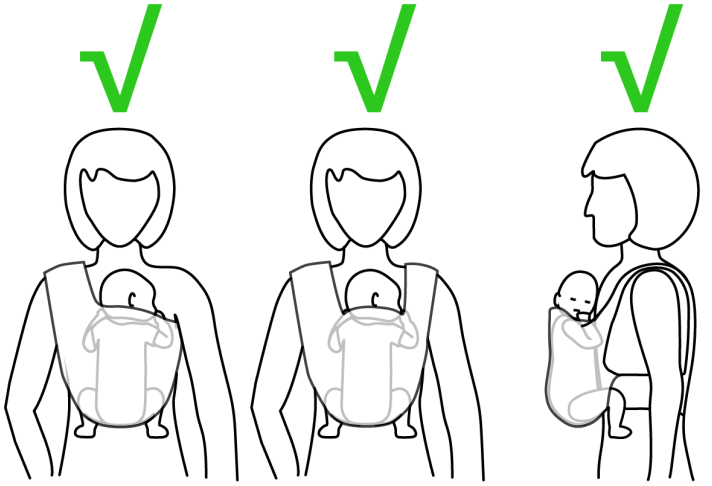
Carry on improving them

Baby carriers have been very popular for some time now. They are believed to be a more 'natural' way of baby transport, with more contact between parent and child than when the child is in a pram cot.

But if babies are not carried correctly, their breathing can be obstructed and their backs damaged by improper strain. This may go unnoticed, as the child will fall asleep and not complain about the posture.

Various studies have been published on the chance of dying due to lack of oxygen, 'positional asphyxia' (choking because of a posture in which breathing is impeded) and heat stroke, or a combination of these.

Wendy Haisma is an occupational therapist, a certified babywearing consultant, and a trainer who trains healthcare professionals to become babywearing consultants (www.draagconsultnoord.nl). She advises the following correct carrying position for a child:

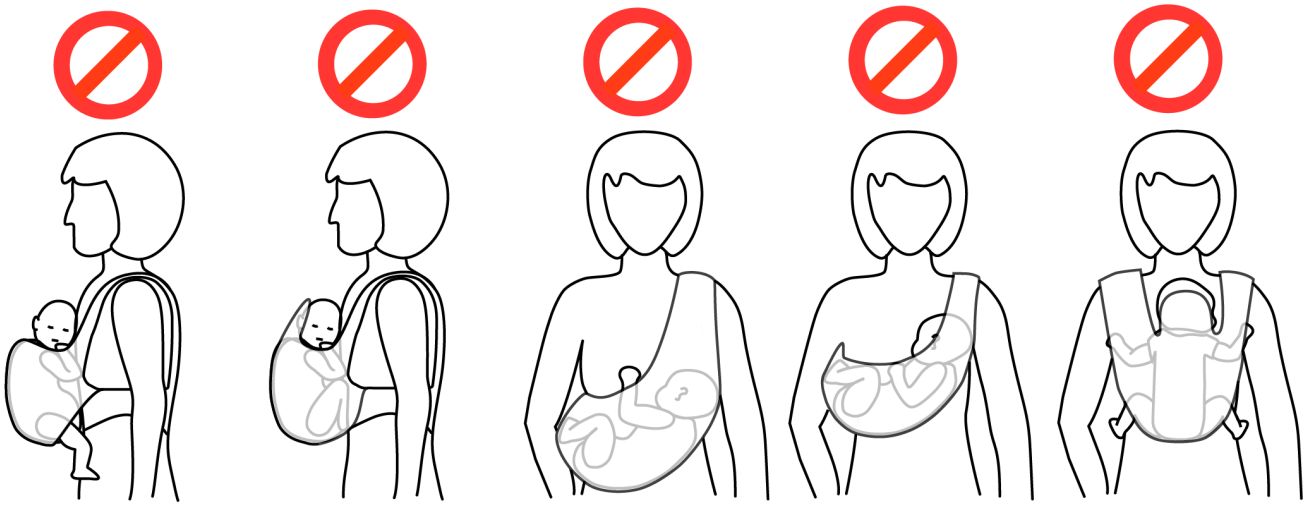


Correct
Upright (optimal)

Correct
Upright (optimal)

Correct
Upright (optimal)

Baby kept close to body; back is straight ('J-shape'); back supported;
chin up and not pressed to chest; face visible;
head supported at the neck, below the ears (not pushing head forward);
nose and mouth free; hands near mouth;
legs slightly spread; knees slightly higher than hips;



Incorrect
Baby is hunched;
baby not kept close to body;
back, neck and head
not supported;
upper legs not supported

Incorrect
Baby is hunched;
baby not kept close to body;
back not supported;
head supported too high
(pressed against wearer);
legs bent and tucked in;

Incorrect
Baby's face covered
and pressed tight
against wearer;
baby is hunched;
back not supported

Incorrect
Baby is hunched with
chin touching chest;
back not supported

Incorrect
Head supported too high;
hands too far from mouth;
knees too high;
legs spread too wide;
lower legs too high

Colophon

Baby Ergonomics Report is an international journal providing information for professionals working on the design, production and sale of baby products.

Baby Ergonomics Report appears irregular.

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Literature

Bergounioux, J. et al., 2015. Sudden deaths in adult-worn baby carriers: 19 cases. *European Journal of Paediatrics,* July 2015. https://doi.org/10.1007/s00431-015-2593-6