Extended Abstract from 21st Triennial Congress of the International Ergonomics Association, Vancouver, June 13 – 18, 2021

Sleeping Postures in Adults: a Preliminary Literature Review

Maxim Smulders and Peter Vink
Industrial Design Engineering, Delft University of Technology,
Landbergstraat 15, 2628CE Delft, The Netherlands, m.smulders@tudelft.nl

SUMMATIVE STATEMENT
In designing sleeping systems for at home, medical contexts and limited spaces in vehicles, knowledge on (dominant) sleeping postures is essential. Literature shows that adults predominantly sleep lateral (55-70%), and in lesser extent supine (20-30%) and prone (5-10%).

KEYWORDS: Sleep, Lateral, Supine, Prone

PROBLEM STATEMENT
In designing sleeping systems for at home (e.g. beds and sleeping sofas), clinical context (e.g. hospital beds, insomnia-, decubitus- and apnoea prevention) and in transit where space is scarcer (e.g. aircraft-, crew-, autonomous car- and long-distance bus seats, crew bunks in aircrafts, ships, submarines and trains), knowledge on sleeping postures is essential in order to provide a comfortable and efficient sleeping environment.

RESEARCH OBJECTIVE/QUESTION
This paper aims to preliminary review, compare and evaluate existing literature on sleeping postures, in order to give an indication of dominance/preference of certain postures in healthy adults as input for defining sleep space and support.

Studies for this literature review were retrieved from Scopus, PubMed and Google Scholar, by using the following search terms: *'sleep'* or *'sleeping'*, and *'posture'* or *'position'*, and *'supine'*, *'back'*, *'dorsal'*, *'lateral'*, *'side'* and/or *'prone'*. The following terms were excluded from the search: *'disorder'*, *'animal'*, *'apnoea'*, *'obesity'* and *'drugs'*. From this set, only original experimental peer-reviewed studies, questionnaires with empirical data, peer-reviewed literature reviews, or books were selected, which:

- Describes postures in minimal terms of lateral, prone and supine, or in more detail;
- Investigates full-flat (180˚; no reclined, upright or zero-gravity sleep) single sleep (no bed partner) in healthy adults (18-65y; no infants, children or elderly);
- Allowed participants to freely choose their postures (thus excluding experiments with predetermined postures).

This search resulted in a limited amount of papers which focussed on sleep posture observations. Therefore, additional papers were searched by following reference threads from the selected articles, articles referring to the selected articles and similar articles (through 'similar articles' option). Papers on sleep, with no specific focus on posture, were also screened on containing information on sleeping postures.

RESULTS
In literature, three main postures are defined: lateral, supine and prone. Within these there are many variations (e.g. limb orientation), but these are not widely studied. Seven studies differentiate between lateral left and right. Only De Koninck, Lorrain, and Gagnon (1992) describe the position of the head, trunk, legs and arms in more detail.

Literature indicates that lateral and supine sleeping postures are dominant, with roughly 55-70% lateral, 20-30% supine and 5-10% prone. Video analysis based studies of De Koninck, Gagnon, and Lallier (1983), De Koninck et al. (1992), Gordon, Grimmer, and Trott (2004), Gordon and Buettner (2009), and Verhaert, Haex, De Wilde, Berckmans, Verbraecken, et al. (2011) found sleeping postures ranging between 55.4-73.0% for lateral, 20.1-32.2% for

supine and 0.5-15.2% for prone. Sensor based studies of Coenen and Kolff (2011), Verhaert, Haex, De Wilde, Berckmans, Vandekerckhove, et al. (2011), Skarpsno, Mork, Nilsen, and Holtermann (2017), and Kaplowitz et al. (2015) found 39.1-60% for lateral, 30.2-55.3% for supine and 5.6-13.6% for prone. Survey based studies on self-reported sleeping posture of Kaplowitz et al. (2015), and Gordon, Grimmer, and Trott (2007) report for lateral 45.5-78%, supine 11.2-25.1% and prone 2.7-6%.

DISCUSSION

Although this collection of literature gives a good indication of dominant sleeping postures, most studies do not predominantly focus on sleeping postures themselves. Six studies only captured postures (e.g. by video or sensor), one study was based solely on questionnaires and one was a combination of the two. Although survey based dominant posture acquisition can be considered as limited, a strong correlation has been found between indicated and actual taken posture before (Gordon et al., 2004; Kaplowitz et al., 2015; Verhaert, Haex, De Wilde, Berckmans, Vandekerckhove, et al., 2011). Of the studies which actually capture postures, some only indicate the initial taken or dominant postures, whereas others show the percentage of postures over total sleep time. The majority of studies consider only three (lateral, supine and prone) or four (with the distinction of lateral left and right) postures, where variations based on limb orientation would give more precise results within these major categories. For defining the ideal sleep envelope at home and a minimal sleep envelope for transportation, detailed posture and movement information is still lacking.

More detailed research is needed on sleeping postures and movement, including the orientation of limbs, and movement (macro- and micro movements) during in-bed time and sleep, in order to define a better sleeping environment.

CONCLUSIONS

Literature indicates that lateral and supine sleeping postures are mostly taken, with roughly 55-70% lateral, 20-30% supine and 5-10% prone.

REFERENCES

Coenen, A.M.L., & Kolff, M. (2011). Body postures in sleep. *Annual Proceedings of the NSWO (Dutch Association for Sleep-Wake Research), 22*, 44-47.

De Koninck, J., Gagnon, P., & Lallier, S. (1983). Sleep positions in the young adult and their relationship with the subjective quality of sleep. *Sleep, 6*(1), 52-59.

De Koninck, J., Lorrain, D., & Gagnon, P. (1992). Sleep positions and position shifts in five age groups: an ontogenetic picture. *Sleep, 15*(2), 143-149.

Gordon, S.J., & Buettner, P.G. (2009). Age and lateral sleep position: a pilot study. *Internet Journal of Allied Health Sciences and Practice, 7*(1), 1-13.

Gordon, S.J., Grimmer, K.A., & Trott, P. (2004). Self-reported versus recorded sleep position: an observational study. *Internet J. of Allied Health Sciences and Practice, 2*(1), 7.

Gordon, S.J., Grimmer, K.A., & Trott, P. (2007). Understanding sleep quality and waking cervico-thoracic symptoms. *Internet Journal of Allied Health Sciences and Practice, 5*, 1-12.

Kaplowitz, K., Blizzard, S., Blizzard, D.J., Nwogu, E., Hamill, C.E., Weinreb, R.N., et al. (2015). Time spent in lateral sleep position and asymmetry in glaucoma. *Investigative ophthalmology & visual science, 56*(6), 3869-3874.

Skarpsno, E.S., Mork, P.J., Nilsen, T.I.L., & Holtermann, A. (2017). Sleep positions and nocturnal body movements based on free-living accelerometer recordings: association with demographics, lifestyle, and insomnia symptoms. *Nature and science of sleep, 9*, 267.

Verhaert, V., Haex, B., De Wilde, T., Berckmans, D., Vandekerckhove, M., Verbraecken, J., et al. (2011). Unobtrusive assessment of motor patterns during sleep based on mattress indentation measurements. *IEEE Trans. on Inform. Techn. in Biomedicine, 15*(5), 787-794.

Verhaert, V., Haex, B., De Wilde, T., Berckmans, D., Verbraecken, J., De Valck, E., et al. (2011). Ergonomics in bed design: the effect of spinal alignment on sleep parameters. *Ergonomics, 54*(2), 169-178.