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Chalmers University of Technology

Production ergonomics

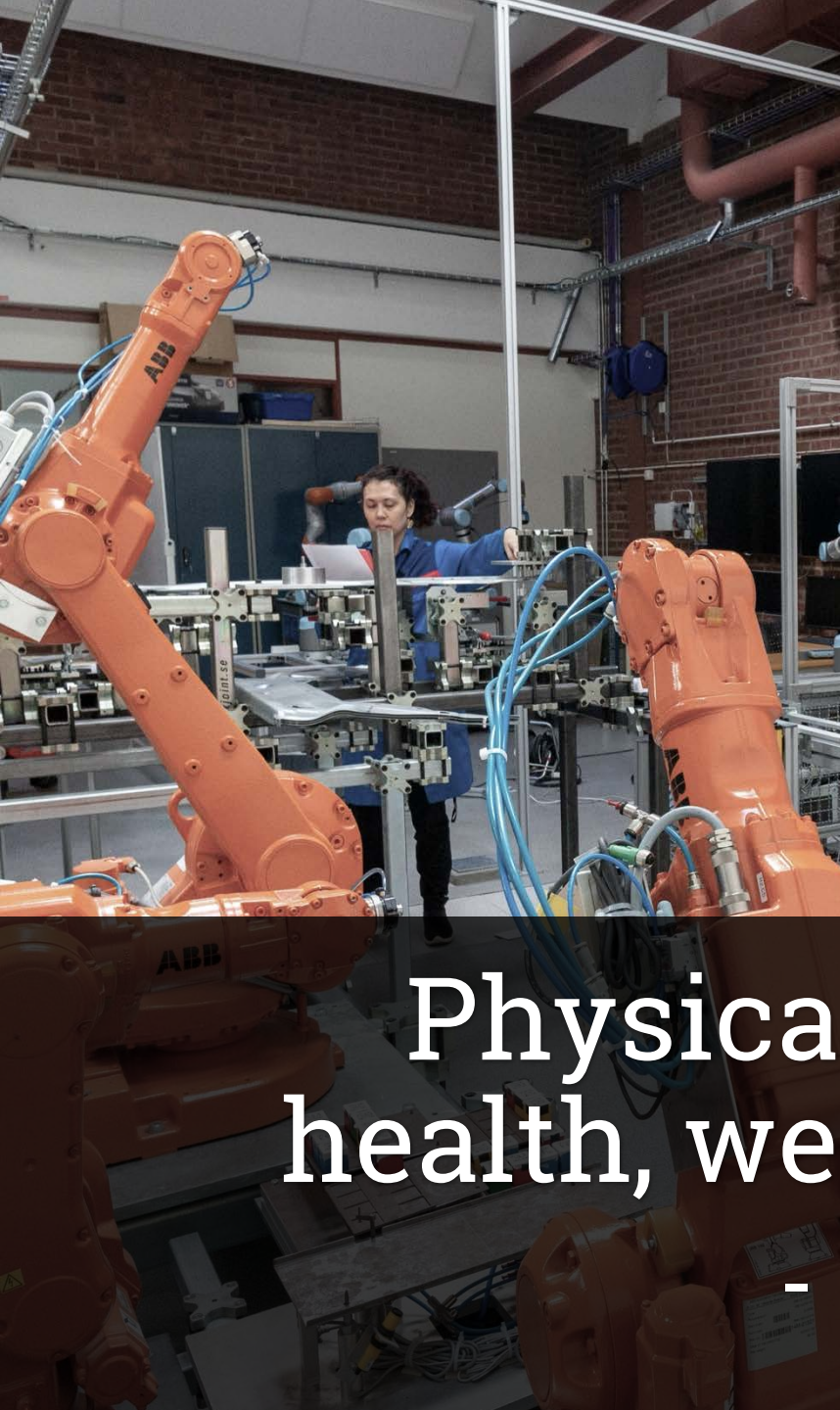
www.bit.ly/ergoberlin



Maral Babapour Chafi, PhD

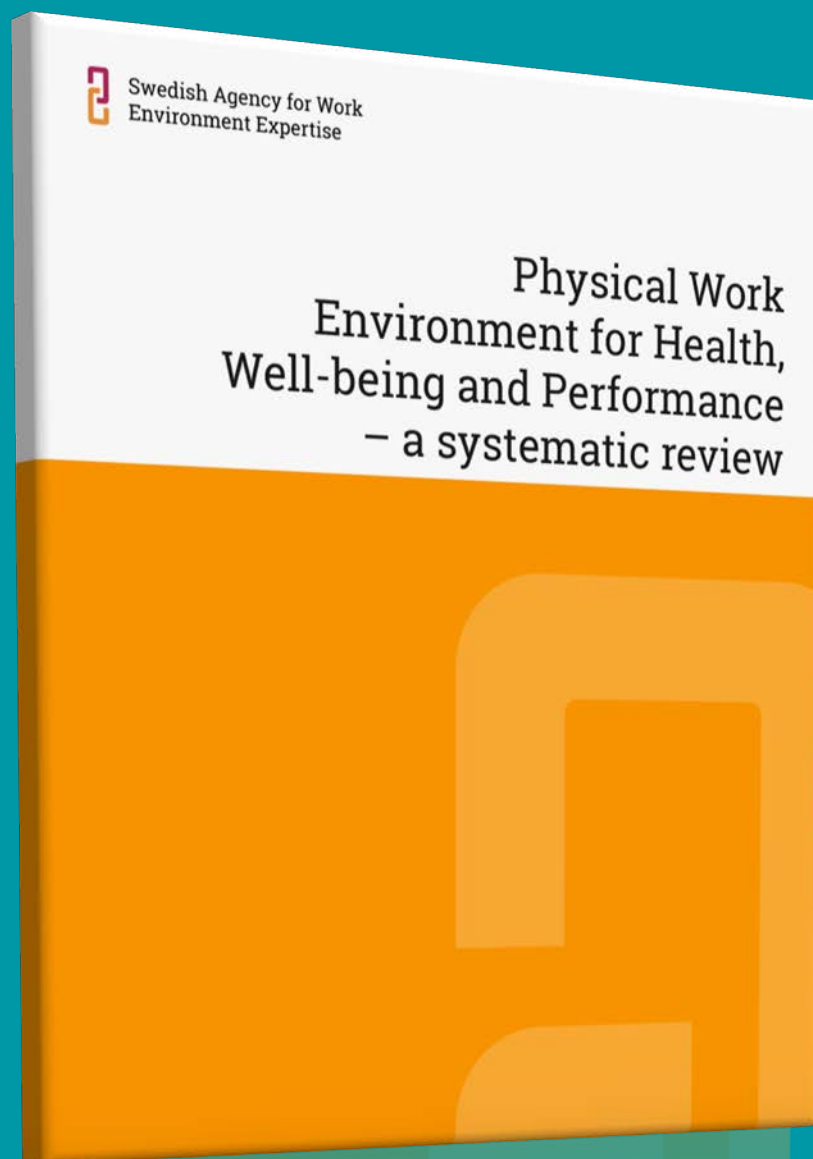
Chalmers University of Technology
& Institute of Stress Medicine

Workplace design & evaluations



Physical work environment for health, well-being and performance - a systematic review

Cecilia Berlin & Maral Babapour Chafi



<< English version of the report

Now available at

www.sawee.se/publications/

Translation of appendices
coming soon!

www.mynak.se/publikationer/



Target audiences

- practitioners who influence the design of physical workplaces
- workplace and equipment users who influence requirements
- purchasers who influence procurement
- policymakers
- educators in architecture, workplace design, product design, process preparation and/or production management



Purpose

- The mission from the Agency:

“to summarize knowledge regarding factors that create sound and healthy workplaces”

- **Friskfaktorer** in Swedish – literal translation: *“good health factors”*
- Our translation: *workplace well-being*



Our interpretation

- A **design** problem – how can we plan, create and maintain physical environments that people use in work activities
- We focus on ***design properties in the physical work environment*** that can be changed to influence ***workplace well-being outcomes***

Guiding questions

- How has the **physical work environment** been designed and developed since 2000, to **promote workplace well-being** for individuals and groups?
- What **principles, technologies, methodologies, processes, working methods and good examples** of workplace design lead to well-being and system performance?



Method

POE	Inclusion criteria	Exclusion criteria
Population	• Blue- & white-collar workers (over 18 years old, incl. ageing population) • Work & workspaces assigned by an employer	• Children or youth • Injured population
Exposure	• Workplace design as a whole or its components • Work environment trends • Process factors, tools, methods and approaches for workplace design	• Indoor Environmental Quality • Work from home • Interventions on individual, psychosocial, organisational & leadership levels
Outcome	• Short- and long-term outcomes of physical, cognitive and organisational nature • Focus on positive well-being and performance	• Work-life balance • Accidents, injuries & sick leave



Swedish Agency for Work
Environment Expertise

Quality
appraisal tools

Empirical studies

McGill Mixed Methods
Appraisal Tool (MMAT)

Literature

Critical Appraisal Skills
Programme (CASP)

Design literature

Custom quality appraisal
for Design literature

References from database searches
(n = 4 299)

References from manual searches
(n = 0)

Reviewed abstracts
(n = 3 225)

Excluded abstracts
(n = 2 779)

Reviewed full-texts
(n = 446)

Excluded full-texts, lack of relevance
(n = 120)

Quality-appraised full-texts
(n = 326)

Excluded full-texts, unsatisfactory quality
(n = 9)

Included empirical and literature studies
(n = 196)

Included design process literature
(n = 121)



Results

317 included articles



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Long-list of included articles (317)

Quality-appraised and then "labelled" according to study type

Empirical studies (182)			Literature studies (14)	Design process literature (121)
MMAT (5 study types)			CASP	Customized appraisal
- Qualitative - Quantitative: - Randomized control study - Non-randomized study - Descriptive study - Mixed methods	(23) (8) (57) (22) (72)	(QL) (RC) (QN-N) (QN-D) (MM)	Literature (L)	Design process (D)
Appendix 2A			Appendix 2B	Appendix 2C



Long-list of included articles (317)

1) Kvalitativa studier (N=23)

Granskningsfrågorna lyder:

1.1. Is the qualitative approach appropriate to answer the research question?

1.2. Are the qualitative data collection methods adequate to address the research question?

1.3. Are the findings adequately derived from the data?

1.4. Is the interpretation of results sufficiently substantiated by data?

1.5. Is there coherence between qualitative data sources, collection, analysis and interpretation?

	Källa	Tillämpnings- henvist	Innehåll (M= män, K=Kvinnor)	Fråga 1.1	Fråga 1.2	Fråga 1.3	Fråga 1.4	Fråga 1.5	Kvalitet
Kval1	Araújo, A. P. de, Maia, M. do C. M., Lima, M. de M., Lopes, P. R. P. F., & Téjo, S. C. P. (2015). Ergonomic Analysis of Work in an Eyeglasses Store. <i>Procedia Manufacturing</i> , 3(Ahfe), 6052–6059.	Övriga yrken	Syfte: kartlägga aktiviteter i en optiker/glasögonaffär och analysera ergonomiska problem kopplade till dessa. Metod: deltagande observation och intervjuer med 2 deltagare (M). Slutsatser: brist på plats medför fysiska besvär, säkerhetsbrister och problem med flöden.	No	Yes	No	Can't tell	Can't tell	Diskutabel
Kval2	Babapour, M., Karlsson, M., & Osvalder, A.-L. (2018). Appropriation of an Activity-based Flexible Office in daily work. <i>Nordic Journal of Working Life Studies</i> , 8(S3), 71–94.	Kunskapsarbete	Syfte: beskriva användares adoption av aktivitetsbaserade kontor (ABW). Metod: skuggningar av 12 deltagare (7K, 5M) under 6 månader efter flytt. Slutsatser: 3 typer av användning förekommer i ABW och variationen beror på kompatibilitet, komplexitet och vilka fördelar som användare upplever.	Yes	Yes	Yes	Yes	Yes	Hög
Kval3	Battisto, D., Pak, R., Vander Wood, M. A., & Pilcher, J. J. (2009). Using a Task Analysis to Describe Nursing Work in Acute Care Patient Environments. <i>JONA: The Journal of Nursing Administration</i> , 39(12), 537–547.	Vård	Syfte: beskriva sjuksköterskors uppgifter i akutvården. Metod: sjuksköterskors arbetsdokumentation, skuggningar av 10 deltagare under en dag och 12 intervjuer Slutsatser: de mest frekventa uppgifterna var dokumentation, bedömning av patienter, och administration av medicinering.	Yes	Yes	Yes	Yes	Yes	Hög
Kval4	Bernardes, M., Trzesniak, C., Trbovich, P., & Mello, C. H. P. (2018). Applying human factors engineering methods for hazard identification and mitigation in the radiotherapy process. <i>Safety Science</i> , 109, 270–280.	Vård	Syfte: identifiera risker och åtgärder i strålbehandling. Metod: icke-deltagande observationer och heuristisk analys. Slutsatser: samspelet mellan människor, teknik, uppgifter och miljön medför risker som kan lindras genom att genomföra ändringar på olika systemnivåer.	Yes	Yes	Yes	Yes	Can't tell	Medelhög



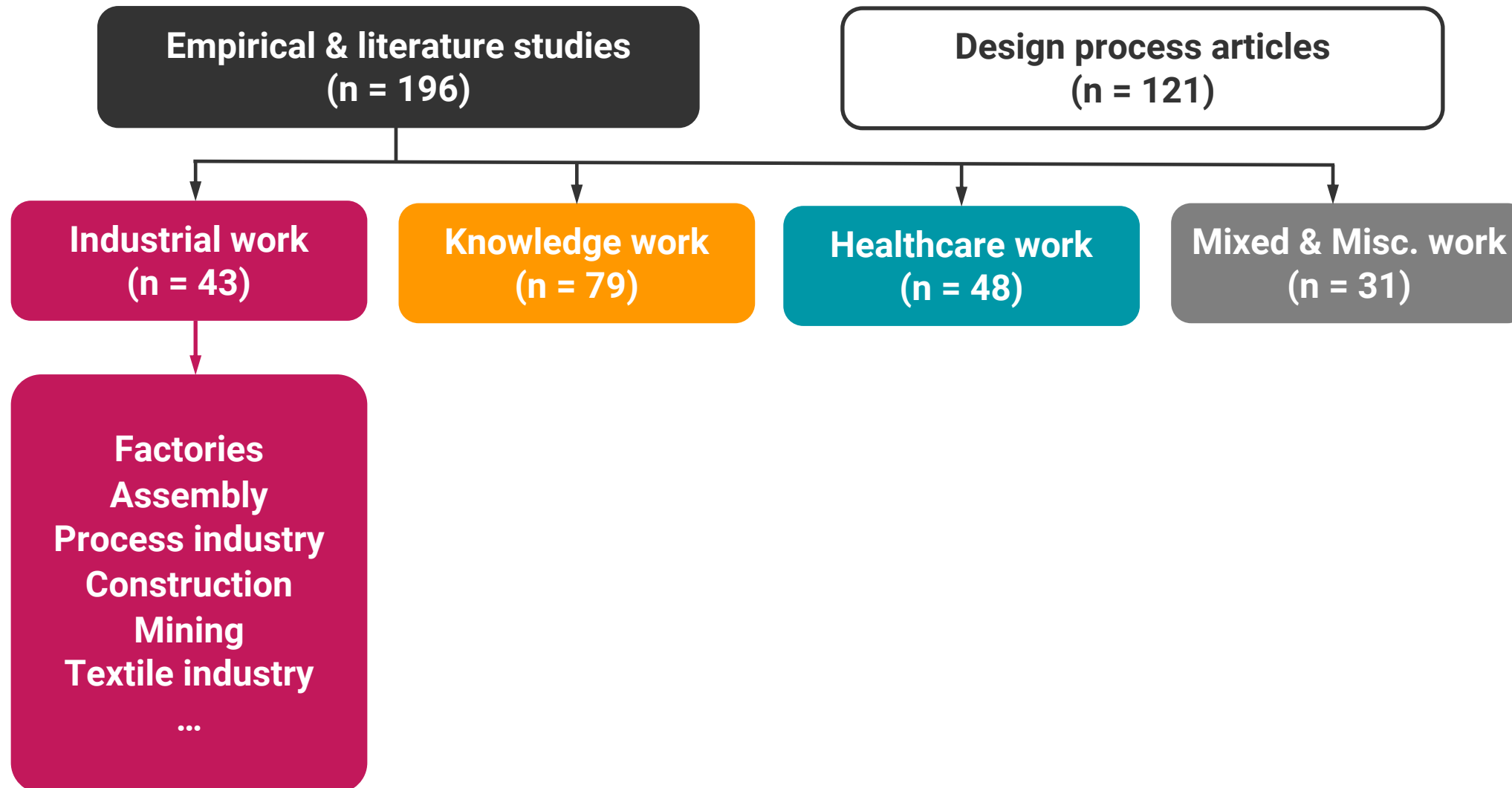
Cutting the cake

Where was the study situated?	What was studied?	For what occupation?
• Field studies (134) • Laboratory studies (45) • Cross-sectional questionnaire studies (53) • Literature studies (14)	• Worksite evaluations (75) • Product evaluations (63) • Risk mapping (85) • Interventions (26) • Ageing (4)	• Industrial work (43) • Knowledge work (79) • Healthcare work (48) • Miscellaneous ("other") occupations (21) • Multiple (combined) occupations (10)



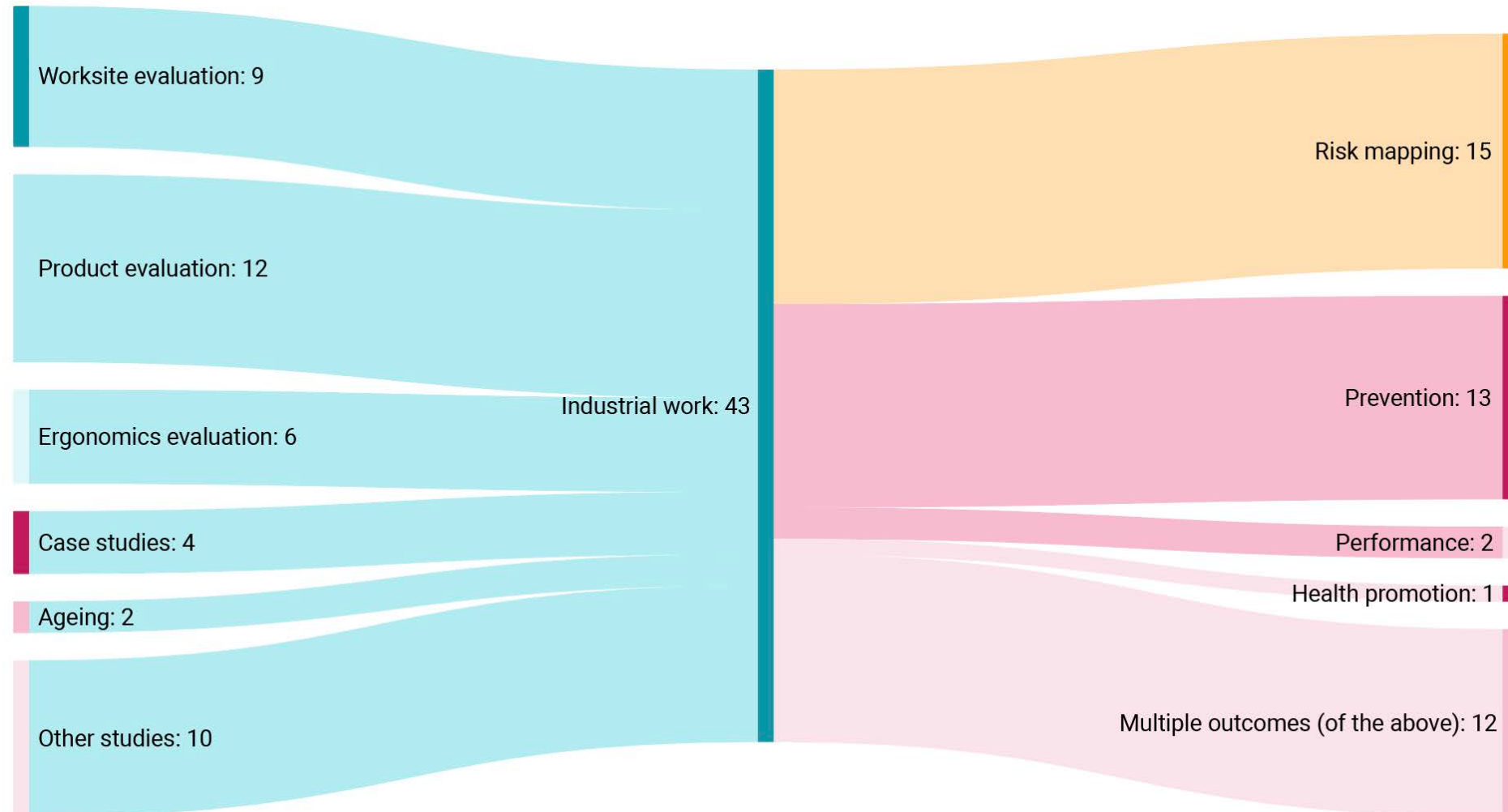
Workplace well-being outcomes

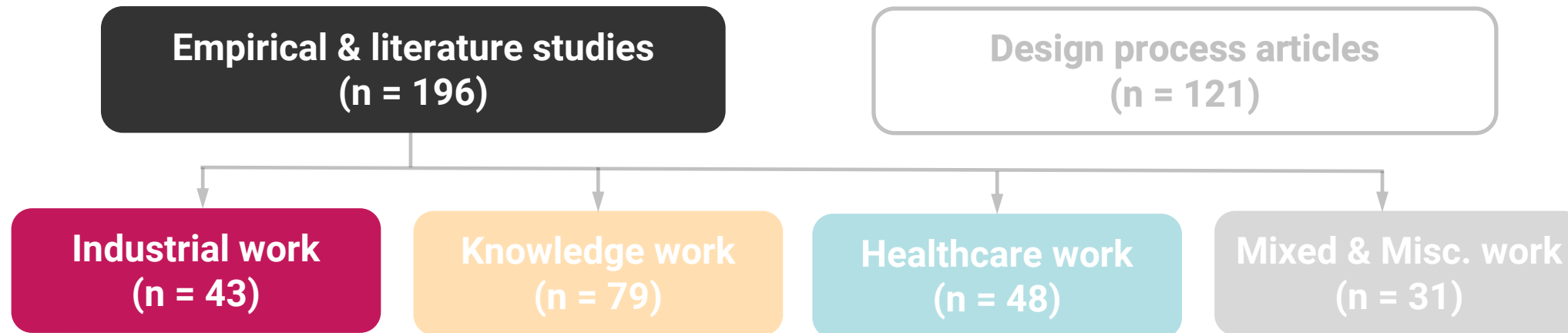






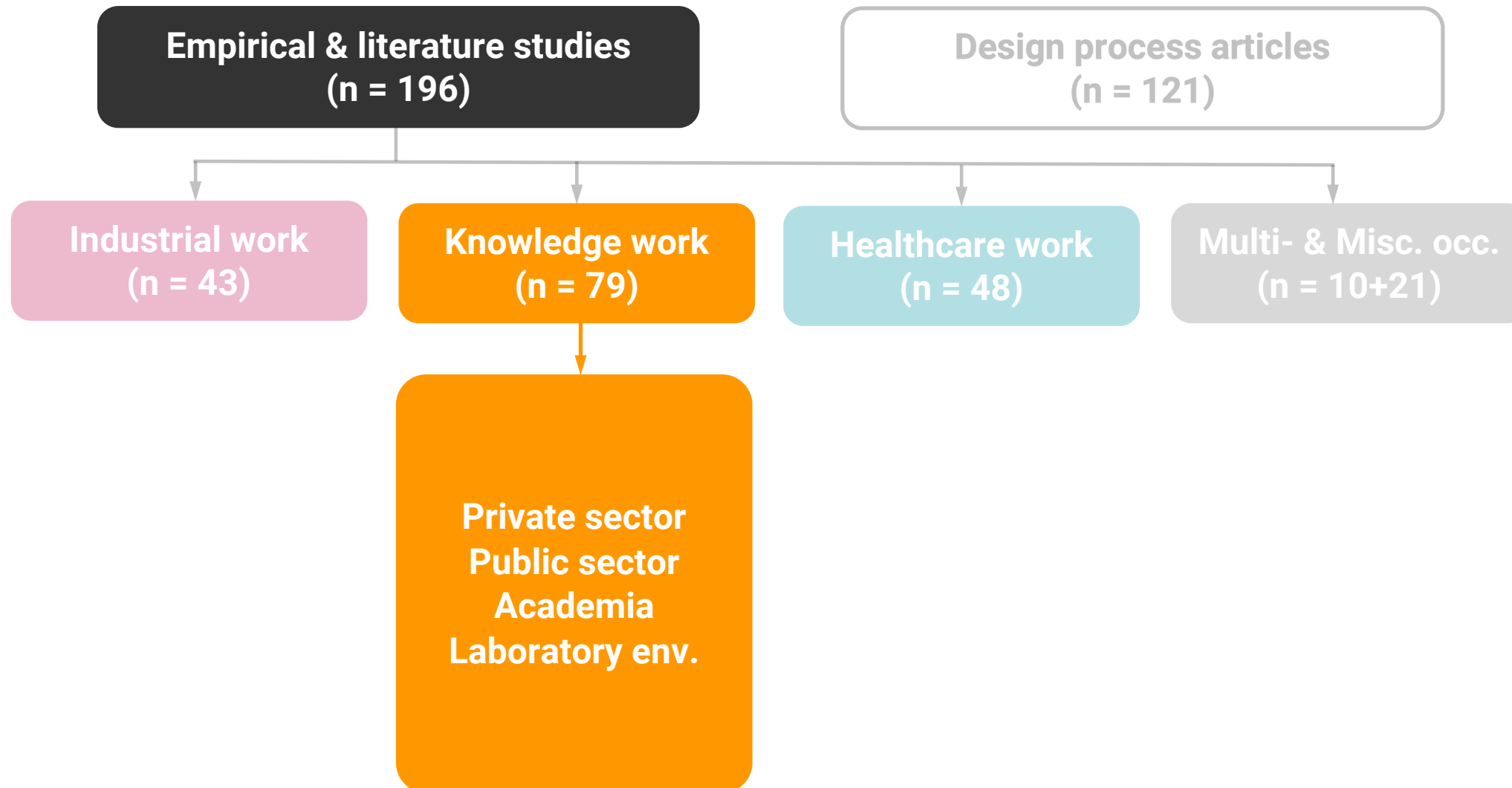
Industrial work





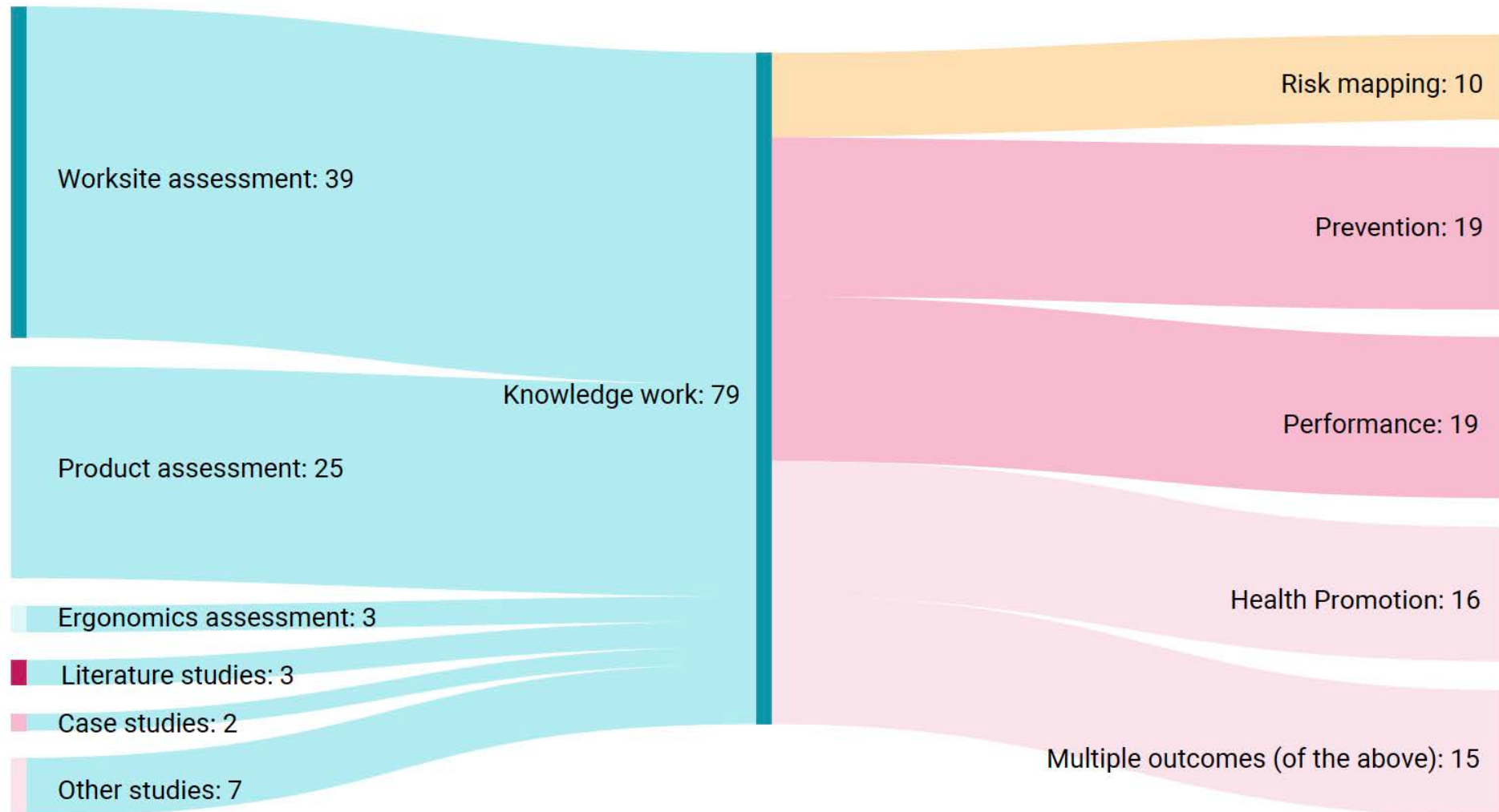
Takeaways

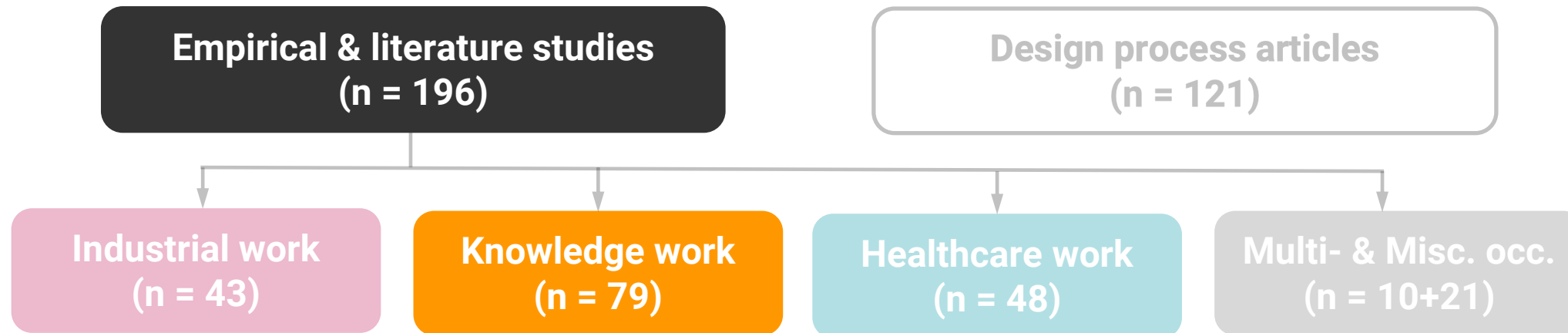
- 1 Largely focused on injury risk prevention and reducing heavy physical loading
- 2 Mainly risk mapping (27), product evaluations (13), worksite evaluations (6)
- 3 Also: 57 design-process related contributions related to Industrial work
- 4 Simulations often used to assess workplace ergonomics or injury risks (design literature)





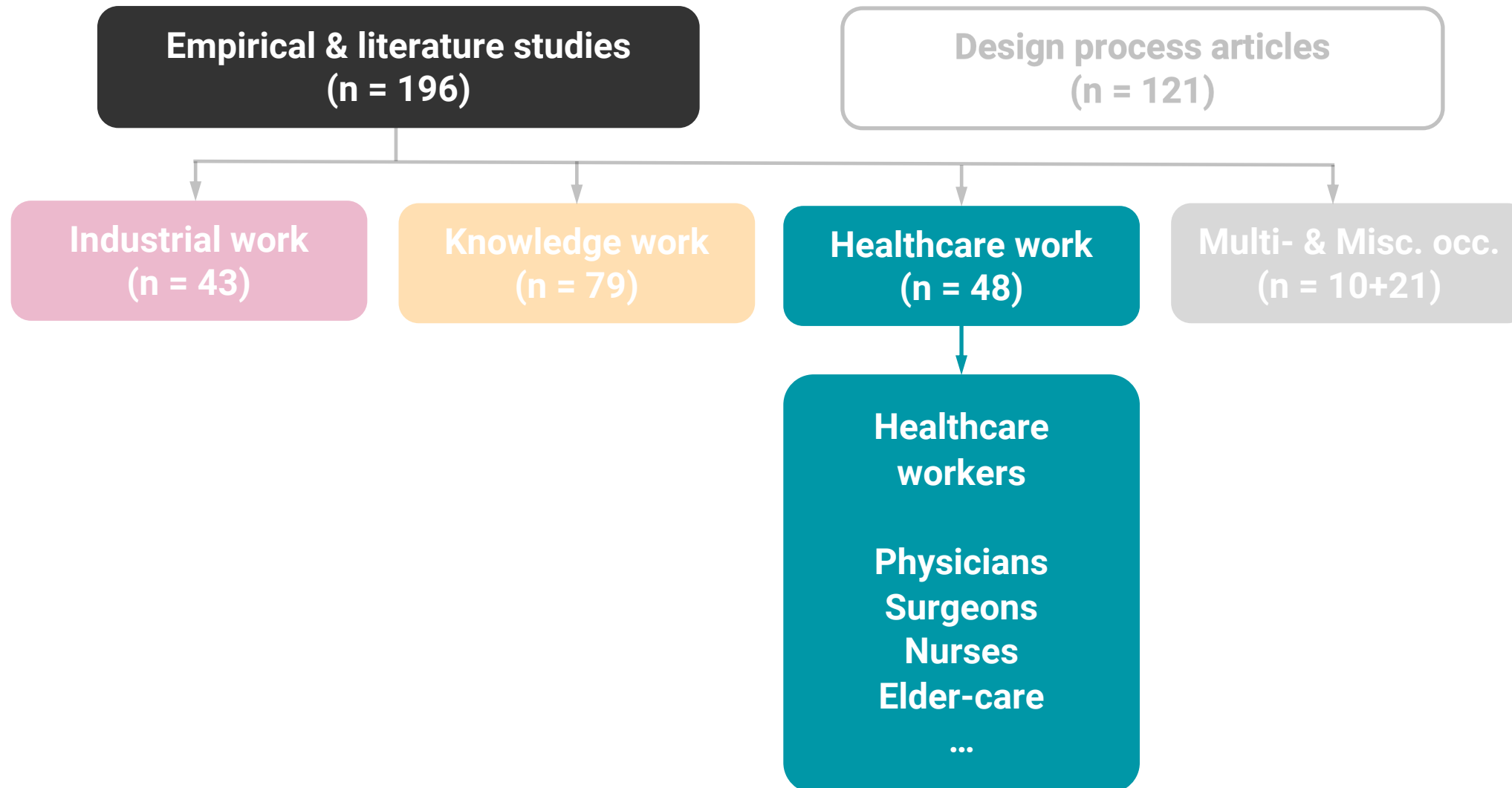
Knowledge work





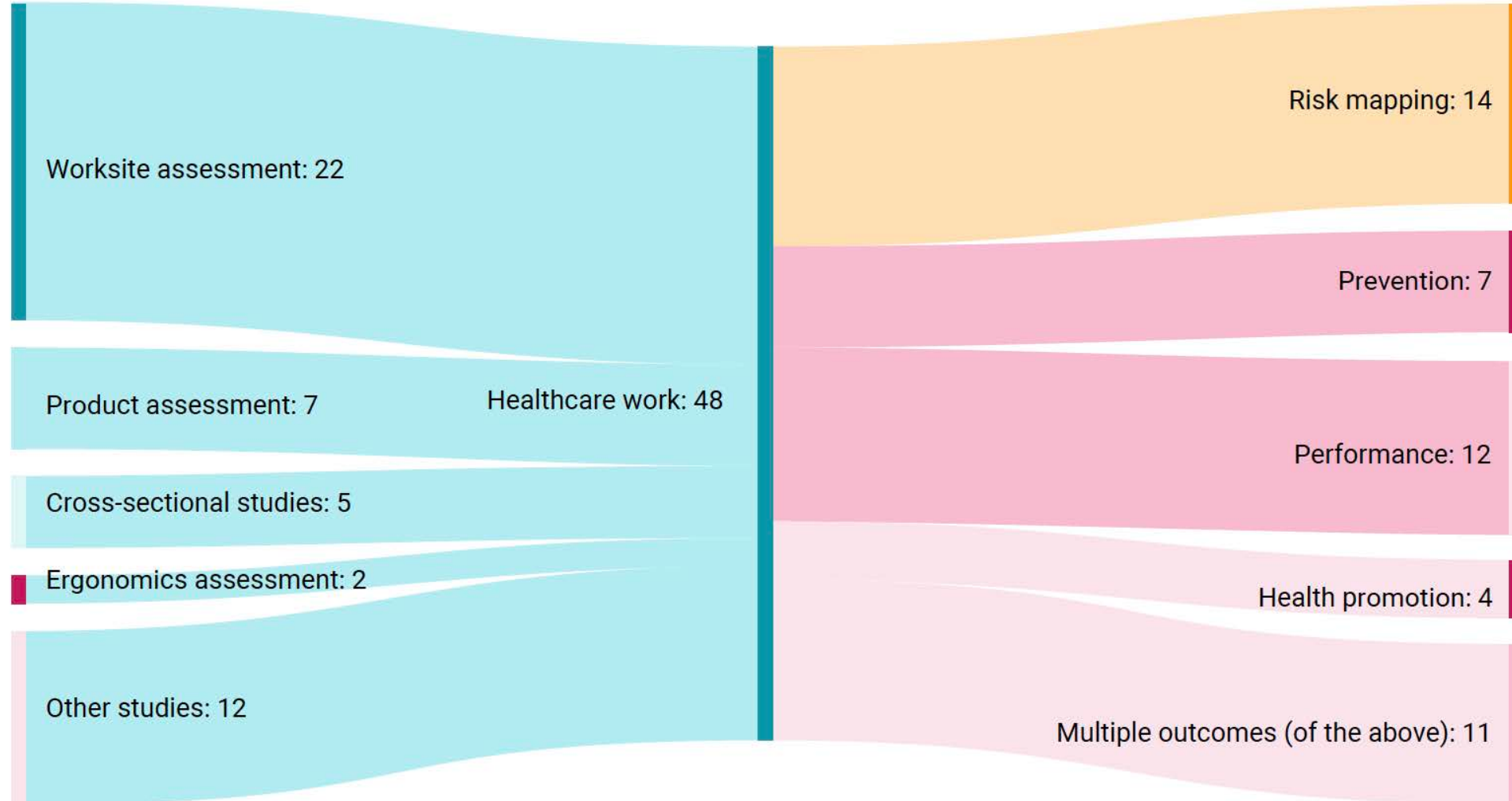
Takeaways

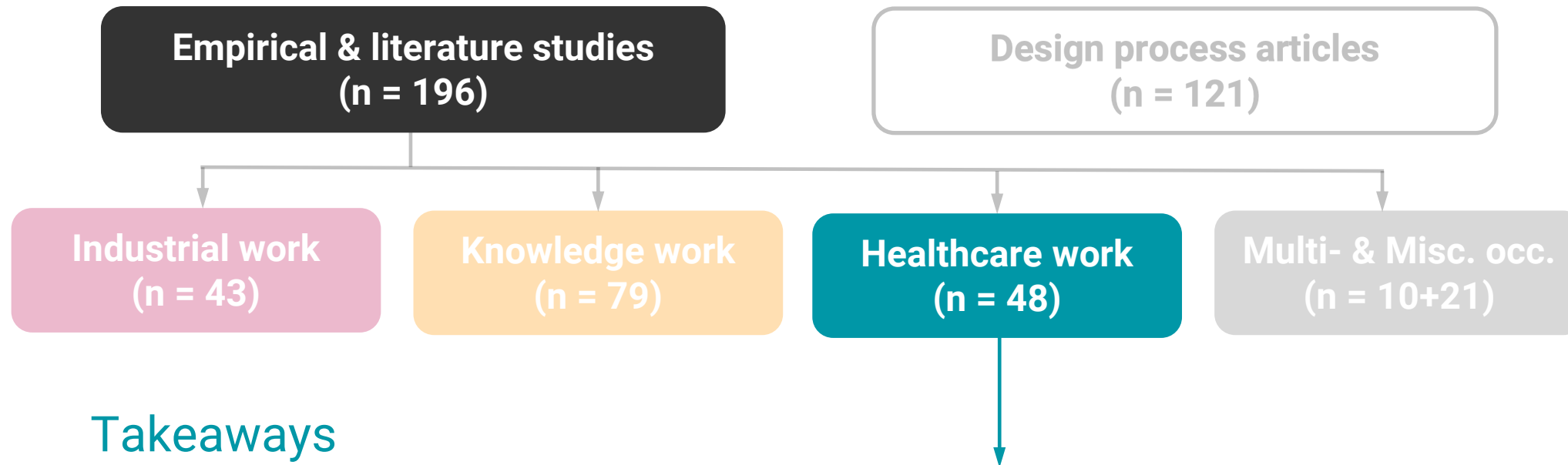
- 1 Large proportion are pre- and/or post-occupancy evaluations of a major workplace intervention
- 2 Plenty of evaluations of chairs, desks, standing/sitting work and data entry devices
- 3 Contact with nature may be a potential resource for healthy stress management





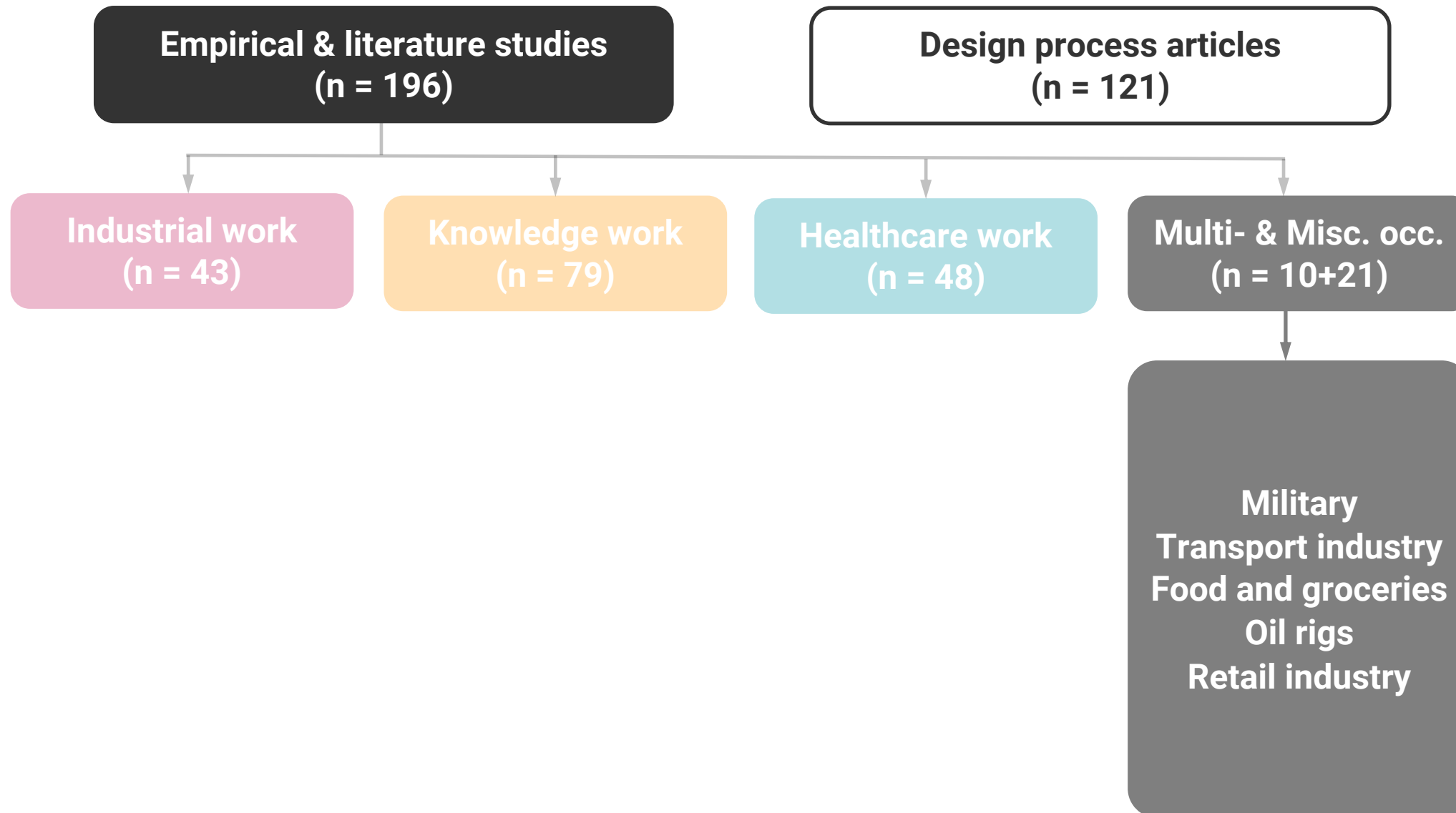
Healthcare work

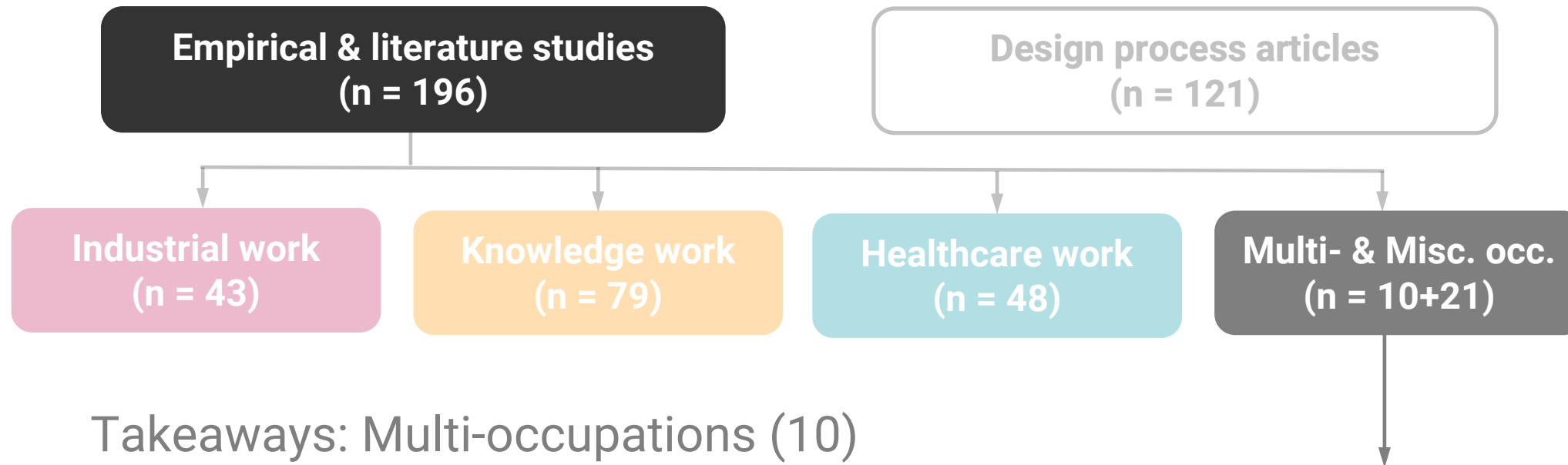




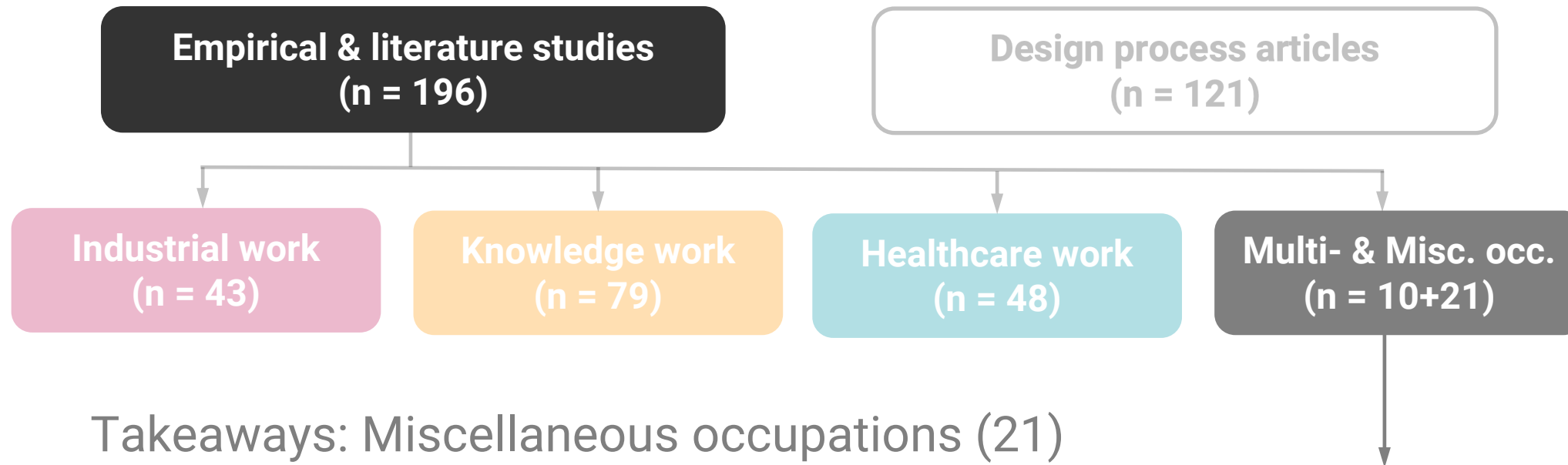
Takeaways

- 1 Generally more focus on patients' perception of care environments, rather than caregivers
- 2 How the work environment can encourage staff to remain in the profession
(e.g. with dedicated break areas)
- 3 Some product evaluations regarding clinical or surgical equipment



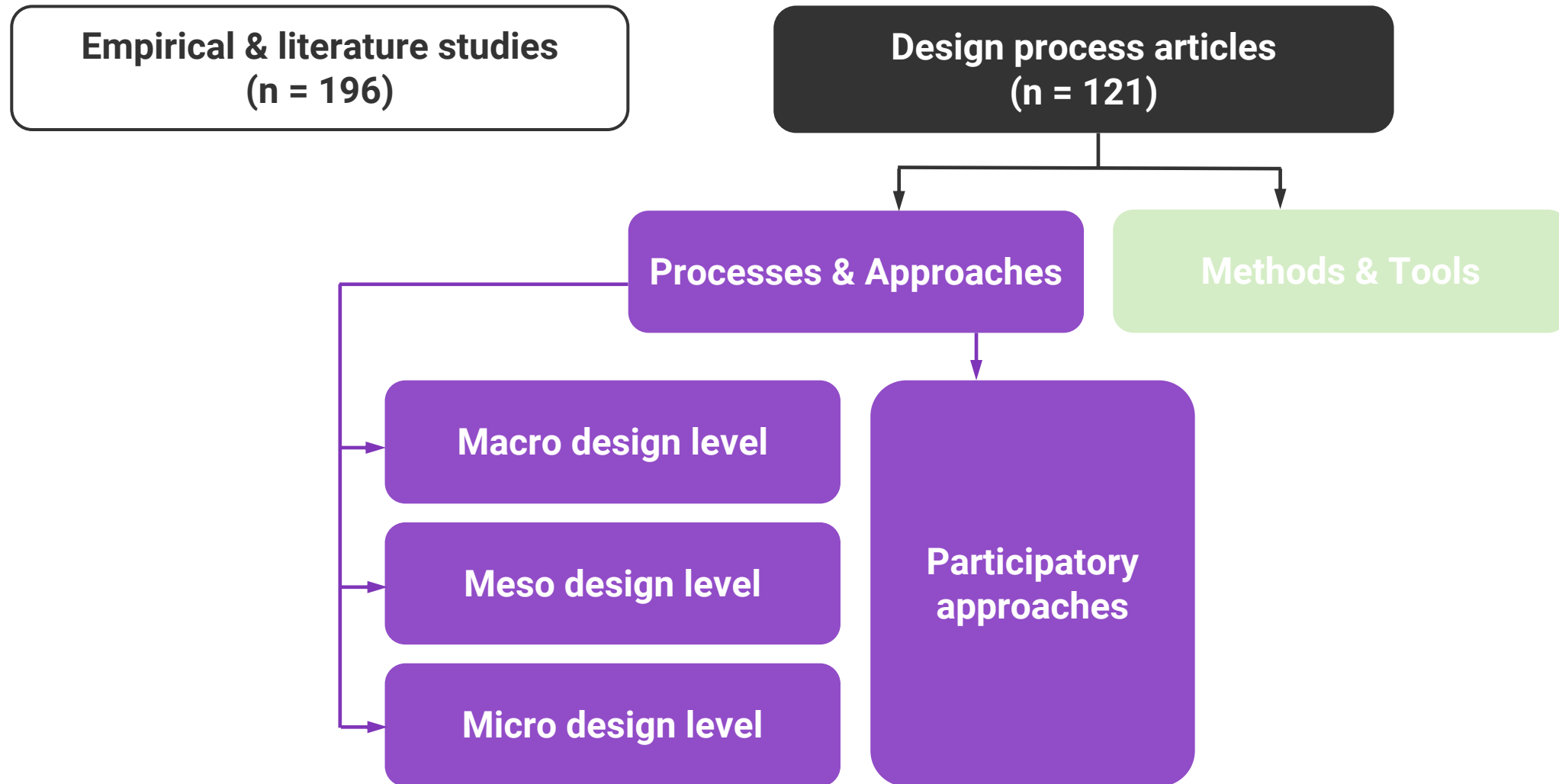


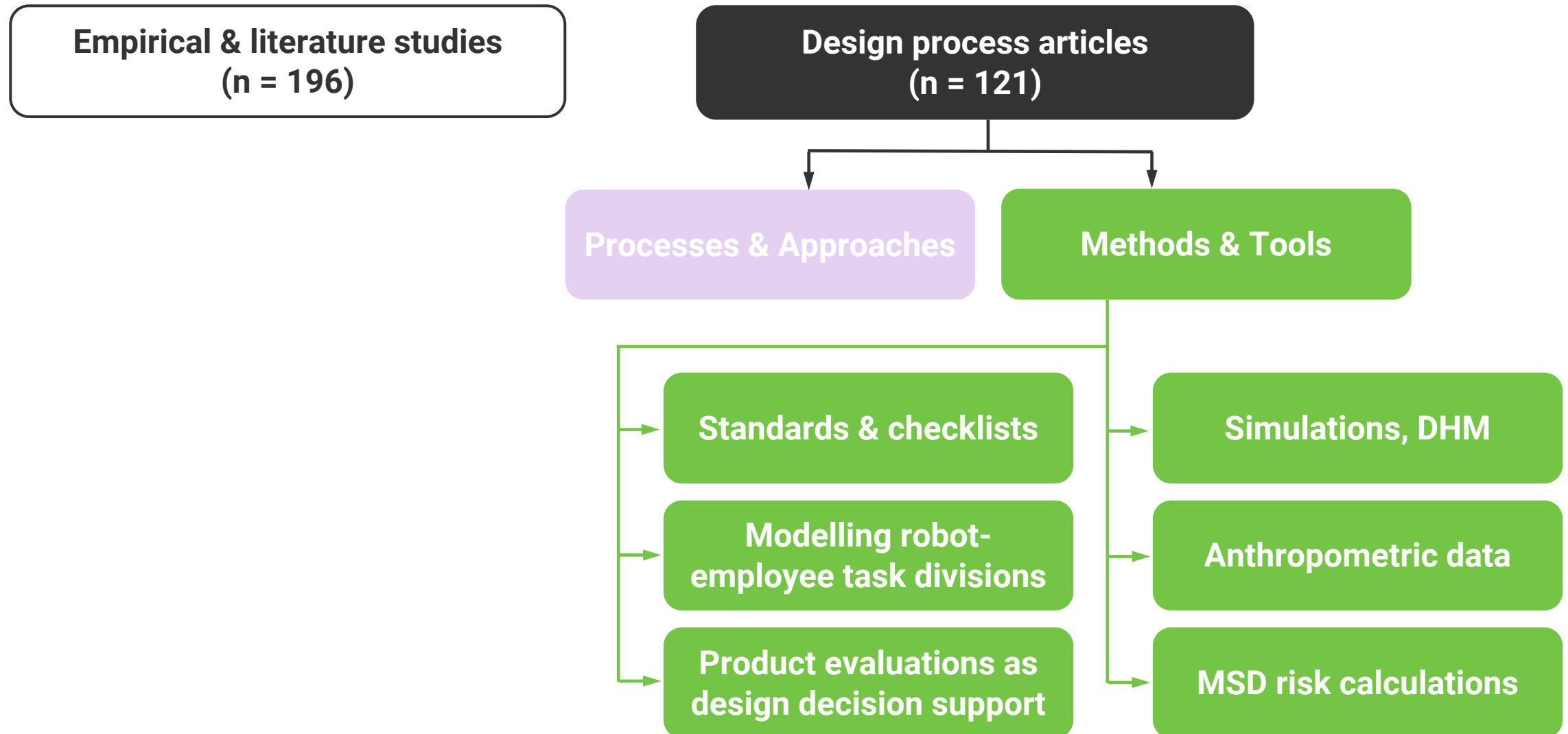
- 1 Most generally applicable findings focus on hand ergonomics, e.g. hand tool studies and a literature review to reduce the risk of hand injury
- 2 Design process literature often focused on participative processes and how they can be facilitated



Takeaways: Miscellaneous occupations (21)

- 1 Specific workplaces with distinct physical demands on employees
- 2 Mostly explorative worksite evaluations to map challenges and injury risks
- 3 Cleaning, veterinary work, dairy and meat farming, offshore industry, aircraft maintenance, military, retail...







Insights & knowledge gaps

- Most results at individual or macro level
 - More research focused on meso level (groups) is recommended
- Workplace and equipment design is contextual
 - More meaningful to examine more deeply one occupation at a time
 - Limited research on product assessments and advice for procurement
 - Limited studies on interaction with smart screens (handheld or wearable technologies) and effects on physical and cognitive workload
 - Unexplored physical implications of using robots as work tools in different occupations
- More studies with parallel assessment are recommended
 - Cognitive and physical workload
 - Temporal factors, scheduling and rotation + design proposals



Insights & knowledge gaps

- Design process
 - Participatory design processes help, but can go wrong
 - Mapping barriers and pitfalls in (participatory) design processes
 - Exploring application of technological innovations such as wearables to support design processes
- Lack of suitable quality-appraisal tools
 - ...for studies in the ergonomics/human factors and design fields, whose contributions are often analytical and work with heuristics (rules of thumb) to quickly screen workplace risks.



Swedish Agency for Work
Environment Expertise

Thank you!

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