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Occupational Safety and Health Impact Assessment (OSHIA)

how to estimate the effects of changes in occupational exposure on health outcomes

Netherlands Organisation for Applied Scientific Research TNO
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Outline

- OSHIA – Occupational Safety and Health Impact Assessment
  - Definitions
  - Practical applicability
- General Impact Assessment Framework
  - Stages in a OSHIA process
  - Methods
- Quantitative test application
  - Research question – awkward posture example
  - Method
  - Results


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OSHIA definitions

- Integrated impact assessment (→ European Commission):

  "*a comparative ex ante evaluation of different policy (or intervention) options. Besides an estimation of socio-economic-, health-, environmental- etc. effects resulting from a policy change or intervention it usually also contains the transposition of these outcome effects into burden of disease measures (e.g. DALYs) and monetary effects via a cost-benefit- or cost-effectiveness analysis.*"

- Working definition OSHIA (→WHO, HIA):

  "a combination of procedures, methods, and tools by which a policy, program, or project may be judged as to its potential effects on the health of a population of workers."

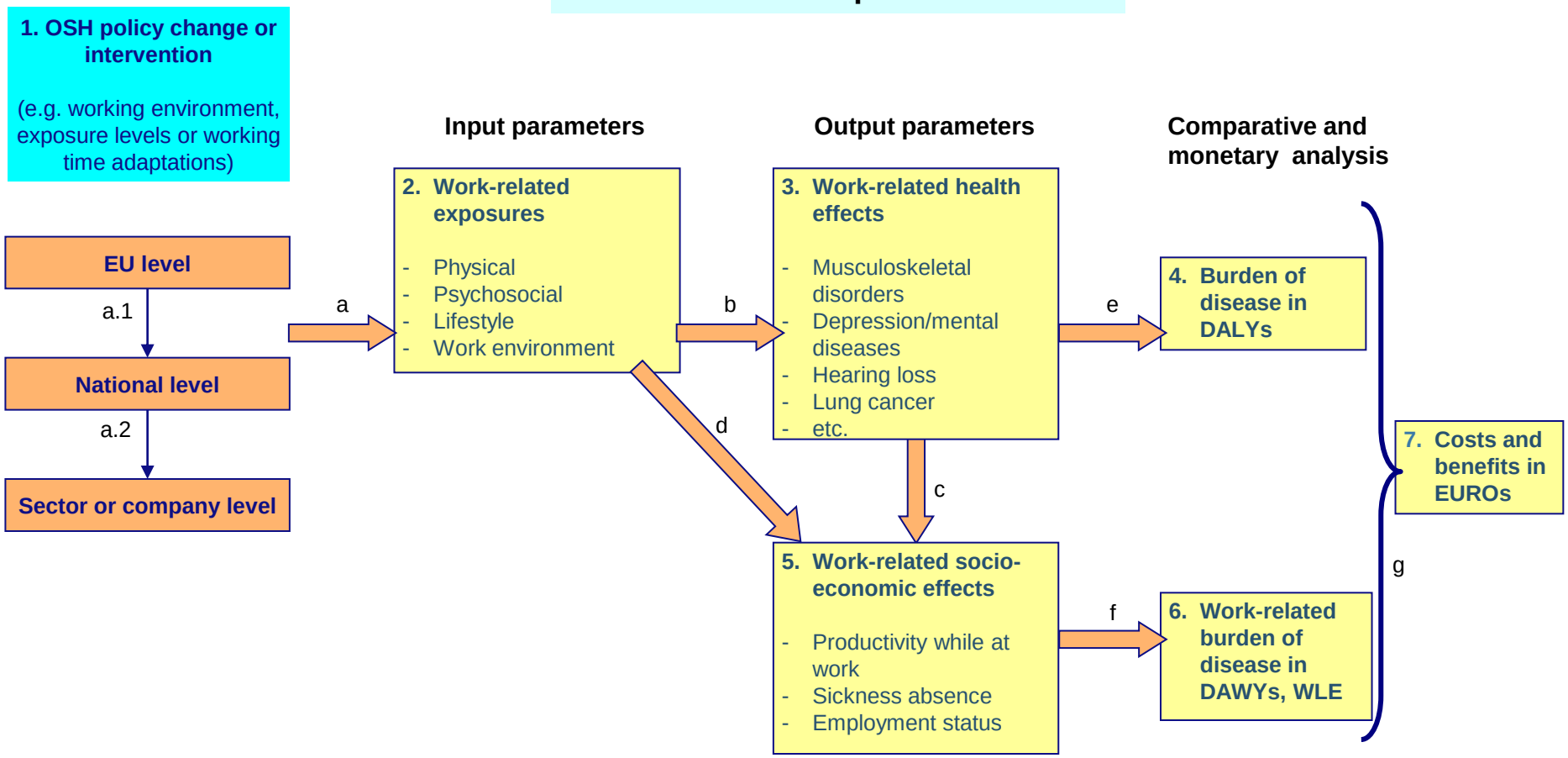
Potential practical applicability

- What are the health effects of changes in OSH regulation? For instance – how does a reduction of heavy lifting affect lower back symptoms of workers?

- What are the socio-economic effects of changes in OSH regulation? For instance – what is the gain in workers' productivity if silica levels in construction work are reduced by 50%?

- Comparing different policy options, which alternative would be most cost effective in reducing working time loss caused by silicosis?

TNO OSHIA conceptual framework



OSHIA stages

I	II	III	IV
Determine affected research level, affected worker population.	Determine affected health determinants.	Determine affected and defined outcome measures (socio-economic, health) and causal relation between health related exposures and outcome measures.	Translate effects on outcome measures into monetary costs/ benefits and burden of disease measures.

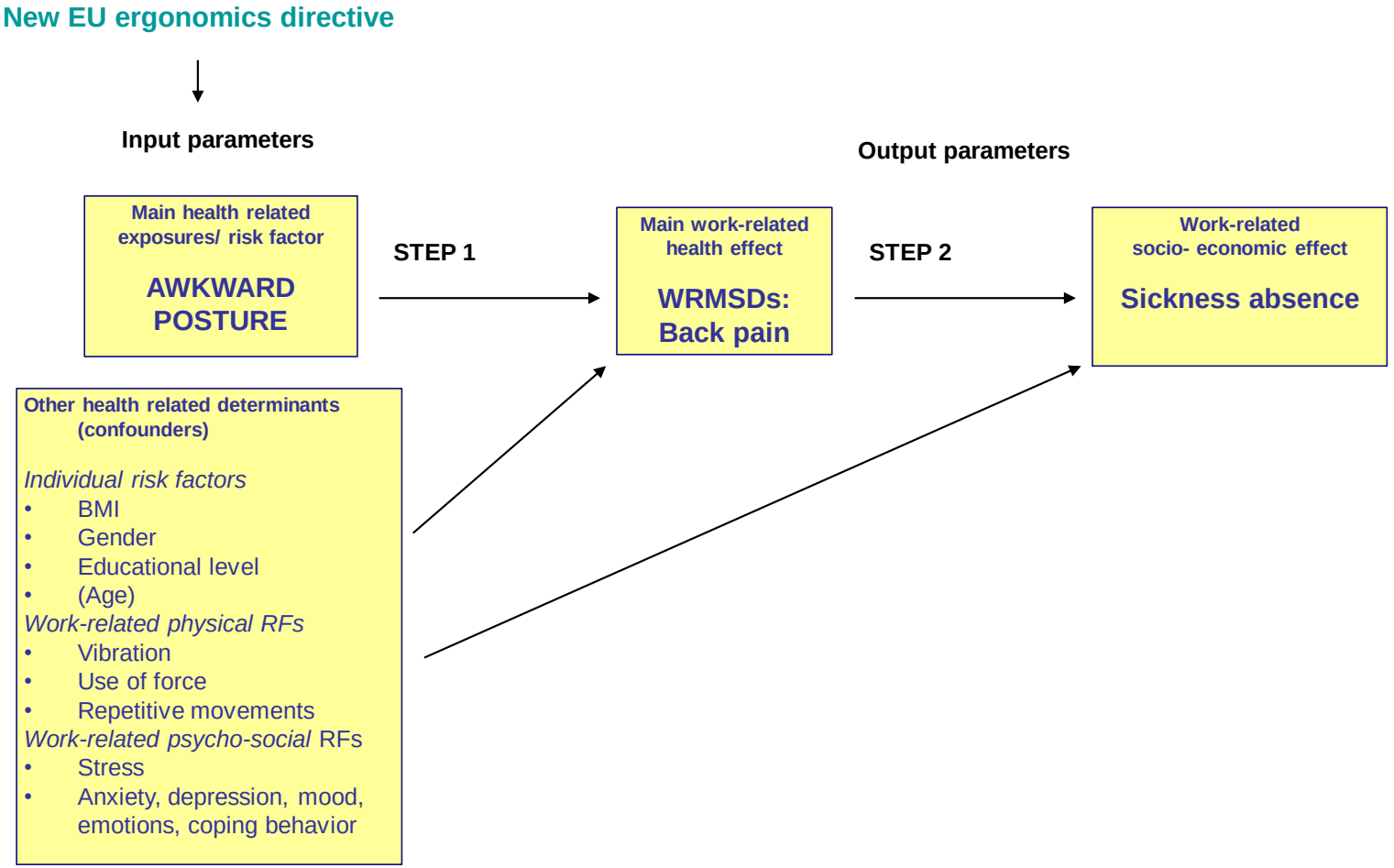
(Legend: a-d = main causal relations; OSH = occupational safety and health; DALYs = disability adjusted life years; DAWYs = disability adjusted working years; WLEs = work life expectancy)

Research question

What is the impact on **back pain** and **sickness absence** if **awkward postures** is covered by binding EU law?

A two-step methodological approach

(limited to step b. and d. in the impact assessment process)



(Legend: OSH = occupational safety and health; WRMSDs = work related musculoskeletal disorders)

Methodological approach

- Data of almost 8.000 persons participating in the Netherlands Working Conditions Cohort Study
- Exposure assessment in 2008 (awkward postures: no, sometimes, regularly)
- Assessment of confounding factors (individual, physical and psychosocial factors) in 2008
- Assessment of outcome (back pain and sickness absence) in 2009
- Multivariate logistic regression analyses to estimate the parameters of the relation between awkward posture and back pain and back pain (2008) and sickness absence
- The inclusion of a parameter representing the hypothetical effect of a policy intervention on exposure to awkward postures

Step 1: Awkward postures → Back pain

Modeled level of **Back Pain**:

Back Pain =
1/(1+exp(-(Constant + 0.42 * **Awkward Postures**$_{\textbf{sometimes}}$ +
0.68 * **Awkward Postures**$_{\textbf{regularly}}$ + Beta confounder(i) * Mean confounder(i))))

Where 0.42 and 0.68 are regression coefficients, empirically estimated from the Netherlands Working Conditions Cohort Survey

Step 2: Back pain → Sickness absence

Modelled level of **Sickness Absence** =

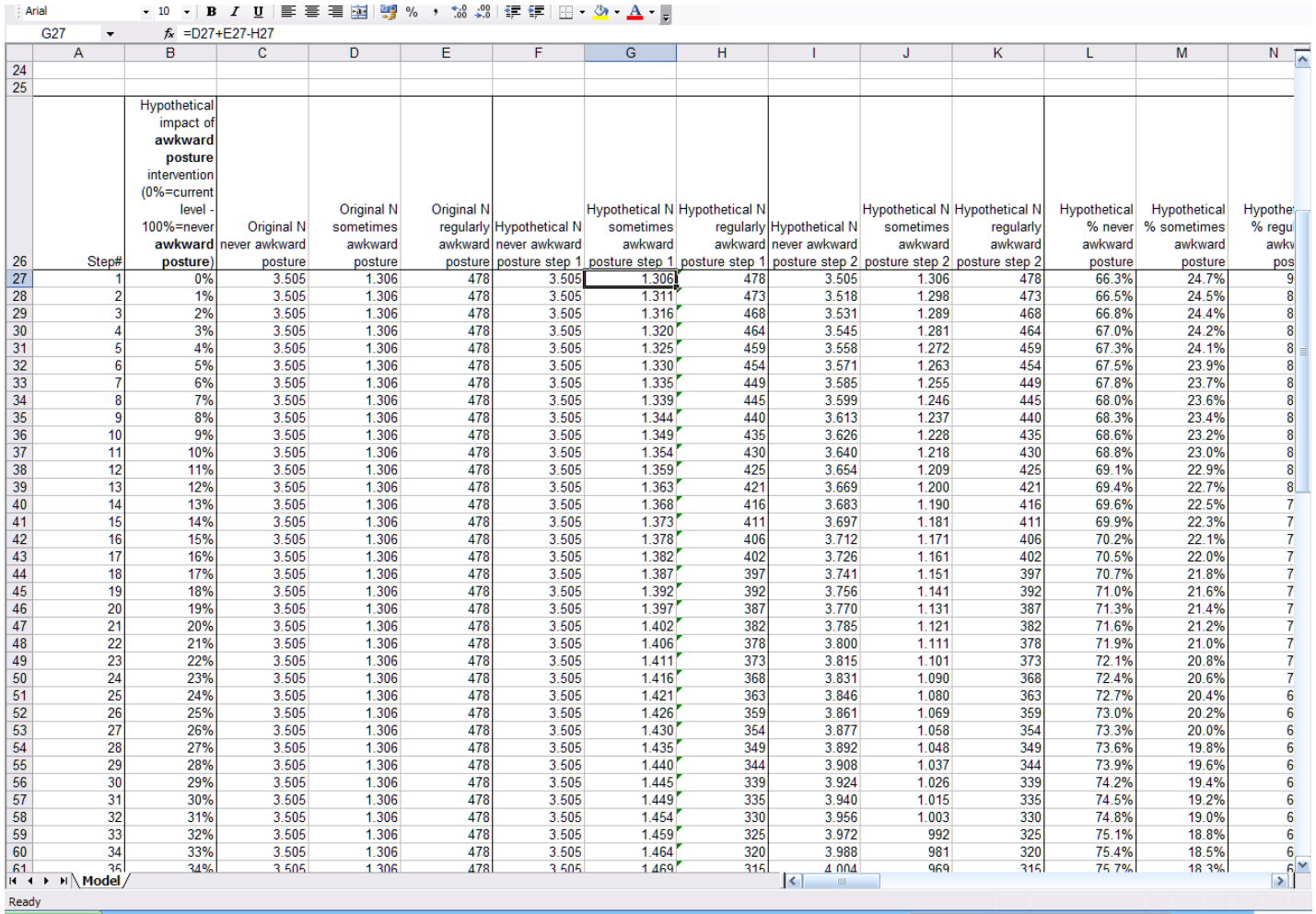
Sickness Absence =
1/(1+exp(-(Constant + 0.33 * **Modeled** level of **Back Pain** in Step 1 + B confounder(i) * Mean confounder(i)+ Error)))

Where 0.33 is a regression coefficient, empirically estimated with data from the Netherlands Working Conditions Cohort Survey

In summary:
The outcome from Step 1 (the **modeled** level of Back Pain),
is used as input in Step 2.

Excel tool 1

every step in hypothetical impact leads to a new distribution of the risk factor categories



Arial 10 B I U

G27 =D27+E27-H27

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
24														
25														
26	Step#	Hypothetical impact of **awkward posture** intervention (0%=current level - 100%=never **awkward posture**)	Original N never awkward posture	Original N sometimes awkward posture	Original N regularly awkward posture	Hypothetical N never awkward posture step 1	Hypothetical N sometimes awkward posture step 1	Hypothetical N regularly awkward posture step 1	Hypothetical N never awkward posture step 2	Hypothetical N sometimes awkward posture step 2	Hypothetical N regularly awkward posture step 2	Hypothetical % never awkward posture	Hypothetical % sometimes awkward posture	Hypothe % regu awkv pos
27	1	0%	3.505	1.306	478	3.505	1.306	478	3.505	1.306	478	66.3%	24.7%	9
28	2	1%	3.505	1.306	478	3.505	1.311	473	3.518	1.298	473	66.5%	24.5%	8
29	3	2%	3.505	1.306	478	3.505	1.316	468	3.531	1.289	468	66.8%	24.4%	8
30	4	3%	3.505	1.306	478	3.505	1.320	464	3.545	1.281	464	67.0%	24.2%	8
31	5	4%	3.505	1.306	478	3.505	1.325	459	3.558	1.272	459	67.3%	24.1%	8
32	6	5%	3.505	1.306	478	3.505	1.330	454	3.571	1.263	454	67.5%	23.9%	8
33	7	6%	3.505	1.306	478	3.505	1.335	449	3.585	1.255	449	67.8%	23.7%	8
34	8	7%	3.505	1.306	478	3.505	1.339	445	3.599	1.246	445	68.0%	23.6%	8
35	9	8%	3.505	1.306	478	3.505	1.344	440	3.613	1.237	440	68.3%	23.4%	8
36	10	9%	3.505	1.306	478	3.505	1.349	435	3.626	1.228	435	68.6%	23.2%	8
37	11	10%	3.505	1.306	478	3.505	1.354	430	3.640	1.218	430	68.8%	23.0%	8
38	12	11%	3.505	1.306	478	3.505	1.359	425	3.654	1.209	425	69.1%	22.9%	8
39	13	12%	3.505	1.306	478	3.505	1.363	421	3.669	1.200	421	69.4%	22.7%	8
40	14	13%	3.505	1.306	478	3.505	1.368	416	3.683	1.190	416	69.6%	22.5%	7
41	15	14%	3.505	1.306	478	3.505	1.373	411	3.697	1.181	411	69.9%	22.3%	7
42	16	15%	3.505	1.306	478	3.505	1.378	406	3.712	1.171	406	70.2%	22.1%	7
43	17	16%	3.505	1.306	478	3.505	1.382	402	3.726	1.161	402	70.5%	22.0%	7
44	18	17%	3.505	1.306	478	3.505	1.387	397	3.741	1.151	397	70.7%	21.8%	7
45	19	18%	3.505	1.306	478	3.505	1.392	392	3.756	1.141	392	71.0%	21.6%	7
46	20	19%	3.505	1.306	478	3.505	1.397	387	3.770	1.131	387	71.3%	21.4%	7
47	21	20%	3.505	1.306	478	3.505	1.402	382	3.785	1.121	382	71.6%	21.2%	7
48	22	21%	3.505	1.306	478	3.505	1.406	378	3.800	1.111	378	71.9%	21.0%	7
49	23	22%	3.505	1.306	478	3.505	1.411	373	3.815	1.101	373	72.1%	20.8%	7
50	24	23%	3.505	1.306	478	3.505	1.416	368	3.831	1.090	368	72.4%	20.6%	7
51	25	24%	3.505	1.306	478	3.505	1.421	363	3.846	1.080	363	72.7%	20.4%	6
52	26	25%	3.505	1.306	478	3.505	1.426	359	3.861	1.069	359	73.0%	20.2%	6
53	27	26%	3.505	1.306	478	3.505	1.430	354	3.877	1.058	354	73.3%	20.0%	6
54	28	27%	3.505	1.306	478	3.505	1.435	349	3.892	1.048	349	73.6%	19.8%	6
55	29	28%	3.505	1.306	478	3.505	1.440	344	3.908	1.037	344	73.9%	19.6%	6
56	30	29%	3.505	1.306	478	3.505	1.445	339	3.924	1.026	339	74.2%	19.4%	6
57	31	30%	3.505	1.306	478	3.505	1.449	335	3.940	1.015	335	74.5%	19.2%	6
58	32	31%	3.505	1.306	478	3.505	1.454	330	3.956	1.003	330	74.8%	19.0%	6
59	33	32%	3.505	1.306	478	3.505	1.459	325	3.972	992	325	75.1%	18.8%	6
60	34	33%	3.505	1.306	478	3.505	1.464	320	3.988	981	320	75.4%	18.5%	6
61	35	34%	3.505	1.306	478	3.505	1.469	315	4.004	969	315	75.7%	18.3%	6

Model

Ready

Excel tool 2

Based on the hypothetical distribution of the risk factor the level of the outcome measures are calculated

Arial 10

P32 =1/(1+EXP(-1*($C$5+SUMPRODUCT($C$6:$C$12,$P$6:$P$12)+$C$13*$M32+$C$14*$N32+SUMPRODUCT($C$15:$C$20,$P$15:$P$20))))

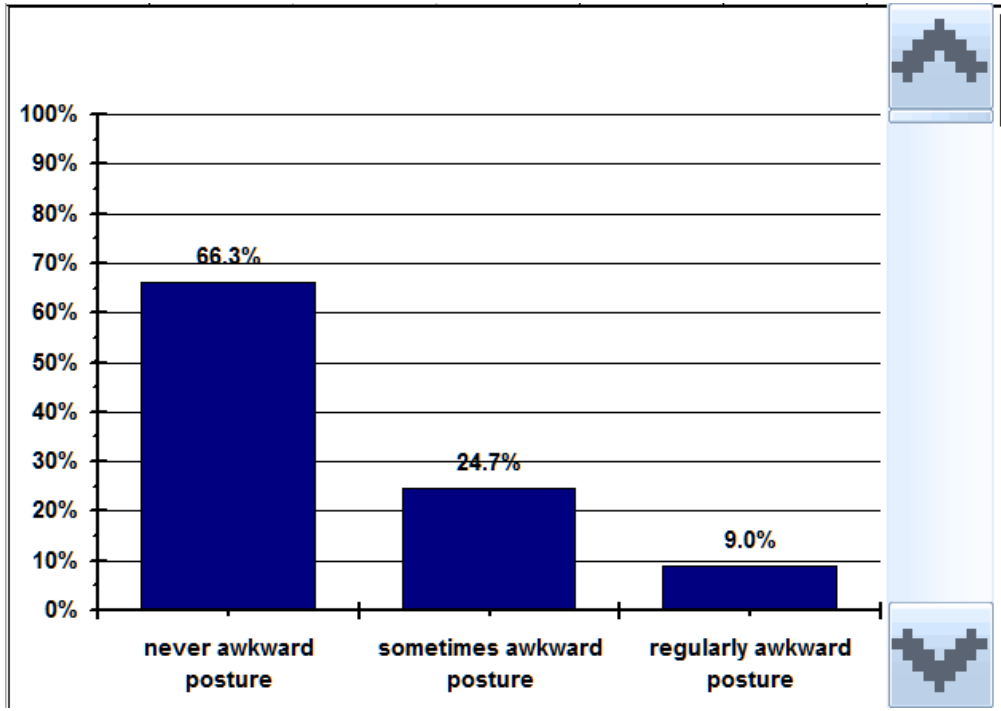
	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
24														
25														
26	Original N regularly awkward posture	Hypothetical N never awkward posture step 1	Hypothetical N sometimes awkward posture step 1	Hypothetical N regularly awkward posture step 1	Hypothetical N never awkward posture step 2	Hypothetical N sometimes awkward posture step 2	Hypothetical N regularly awkward posture step 2	Hypothetical % never awkward posture	Hypothetical % sometimes awkward posture	Hypothetical % regularly awkward posture	Hypothetical mean awkward posture	**Modeled proportion back pain**	Hypothetical impact of **awkward posture** intervention (0%=current level - 100%=never **awkward posture**)	Hypothe % n awkv pos
27	478	3.505	1.306	478	3.505	1.306	478	66.3%	24.7%	9.0%	1.43	27.2%	20%	71
28	478	3.505	1.311	473	3.518	1.298	473	66.5%	24.5%	8.9%	1.42	27.1%		
29	478	3.505	1.316	468	3.531	1.289	468	66.8%	24.4%	8.9%	1.42	27.1%		
30	478	3.505	1.320	464	3.545	1.281	464	67.0%	24.2%	8.8%	1.42	27.1%		
31	478	3.505	1.325	459	3.558	1.272	459	67.3%	24.1%	8.7%	1.41	27.1%		
32	478	3.505	1.330	454	3.571	1.263	454	67.5%	23.9%	8.6%	1.41	27.0%		
33	478	3.505	1.335	449	3.585	1.255	449	67.8%	23.7%	8.5%	1.41	27.0%		
34	478	3.505	1.339	445	3.599	1.246	445	68.0%	23.6%	8.4%	1.40	27.0%		
35	478	3.505	1.344	440	3.613	1.237	440	68.3%	23.4%	8.3%	1.40	27.0%		
36	478	3.505	1.349	435	3.626	1.228	435	68.6%	23.2%	8.2%	1.40	26.9%		
37	478	3.505	1.354	430	3.640	1.218	430	68.8%	23.0%	8.1%	1.39	26.9%		
38	478	3.505	1.359	425	3.654	1.209	425	69.1%	22.9%	8.0%	1.39	26.9%		
39	478	3.505	1.363	421	3.669	1.200	421	69.4%	22.7%	8.0%	1.39	26.9%		
40	478	3.505	1.368	416	3.683	1.190	416	69.6%	22.5%	7.9%	1.38	26.8%		
41	478	3.505	1.373	411	3.697	1.181	411	69.9%	22.3%	7.8%	1.38	26.8%		
42	478	3.505	1.378	406	3.712	1.171	406	70.2%	22.1%	7.7%	1.38	26.8%		
43	478	3.505	1.382	402	3.726	1.161	402	70.5%	22.0%	7.6%	1.37	26.7%		
44	478	3.505	1.387	397	3.741	1.151	397	70.7%	21.8%	7.5%	1.37	26.7%		
45	478	3.505	1.392	392	3.756	1.141	392	71.0%	21.6%	7.4%	1.36	26.7%		
46	478	3.505	1.397	387	3.770	1.131	387	71.3%	21.4%	7.3%	1.36	26.7%		
47	478	3.505	1.402	382	3.785	1.121	382	71.6%	21.2%	7.2%	1.36	26.6%		
48	478	3.505	1.406	378	3.800	1.111	378	71.9%	21.0%	7.1%	1.35	26.6%		
49	478	3.505	1.411	373	3.815	1.101	373	72.1%	20.8%	7.0%	1.35	26.6%		
50	478	3.505	1.416	368	3.831	1.090	368	72.4%	20.6%	7.0%	1.35	26.5%		
51	478	3.505	1.421	363	3.846	1.080	363	72.7%	20.4%	6.9%	1.34	26.5%		
52	478	3.505	1.426	359	3.861	1.069	359	73.0%	20.2%	6.8%	1.34	26.5%		
53	478	3.505	1.430	354	3.877	1.058	354	73.3%	20.0%	6.7%	1.33	26.5%		
54	478	3.505	1.435	349	3.892	1.048	349	73.6%	19.8%	6.6%	1.33	26.4%		
55	478	3.505	1.440	344	3.908	1.037	344	73.9%	19.6%	6.5%	1.33	26.4%		
56	478	3.505	1.445	339	3.924	1.026	339	74.2%	19.4%	6.4%	1.32	26.4%		
57	478	3.505	1.449	335	3.940	1.015	335	74.5%	19.2%	6.3%	1.32	26.3%		
58	478	3.505	1.454	330	3.956	1.003	330	74.8%	19.0%	6.2%	1.31	26.3%		
59	478	3.505	1.459	325	3.972	992	325	75.1%	18.8%	6.1%	1.31	26.3%		
60	478	3.505	1.464	320	3.988	981	320	75.4%	18.5%	6.1%	1.31	26.3%		
61	478	3.505	1.469	315	4.004	969	315	75.7%	18.3%	6.0%	1.30	26.2%		

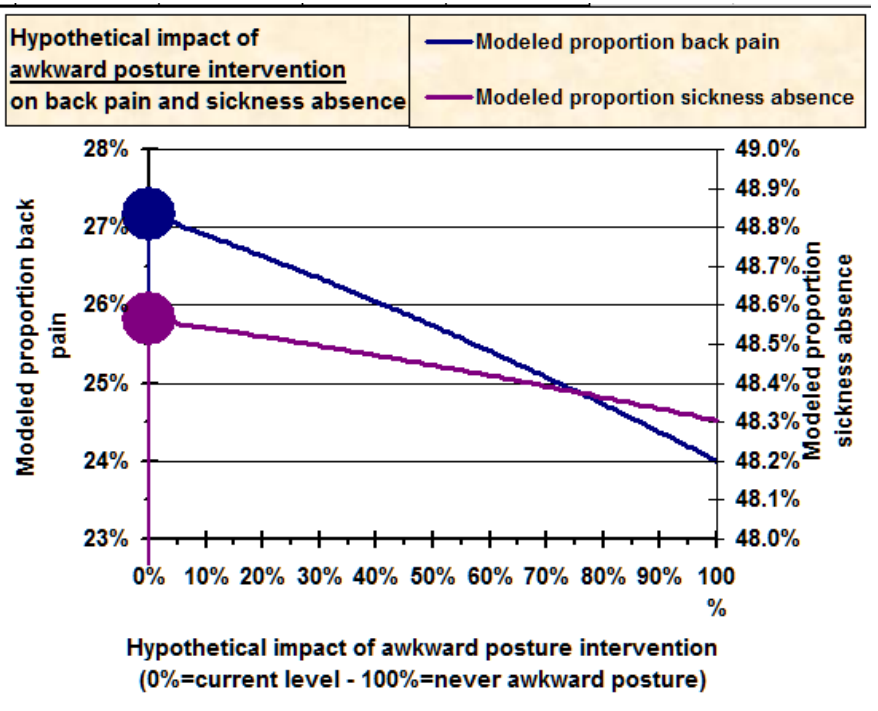
Model

Ready

No intervention or intervention without impact

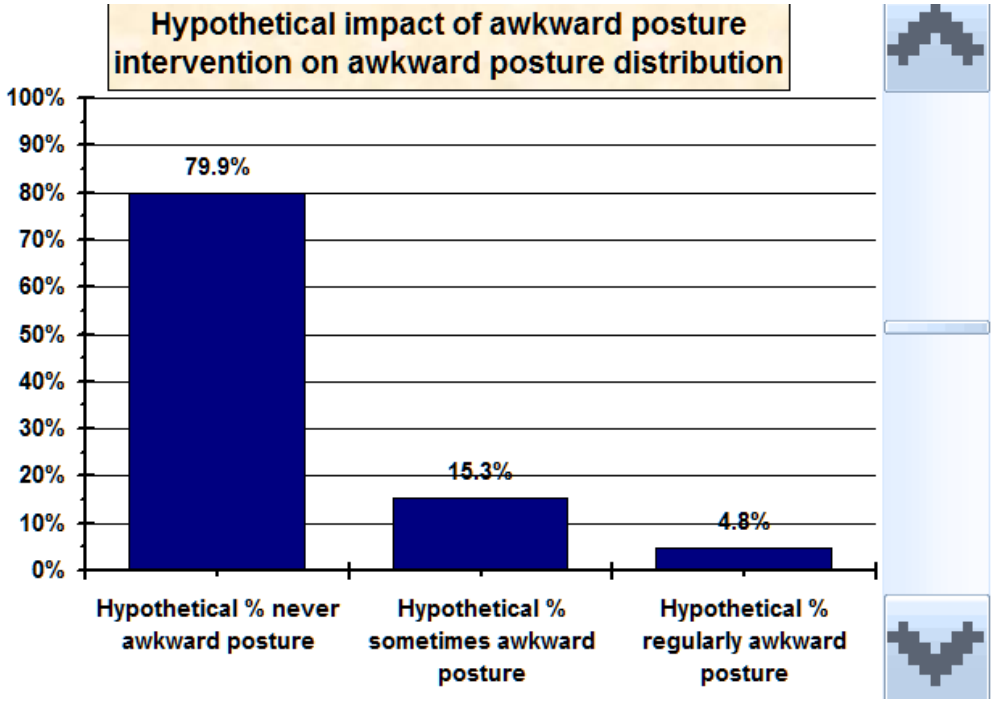
- Exposure to awkward postures 33.7%
- Back pain 27.2%
- Sickness absence 48.6%

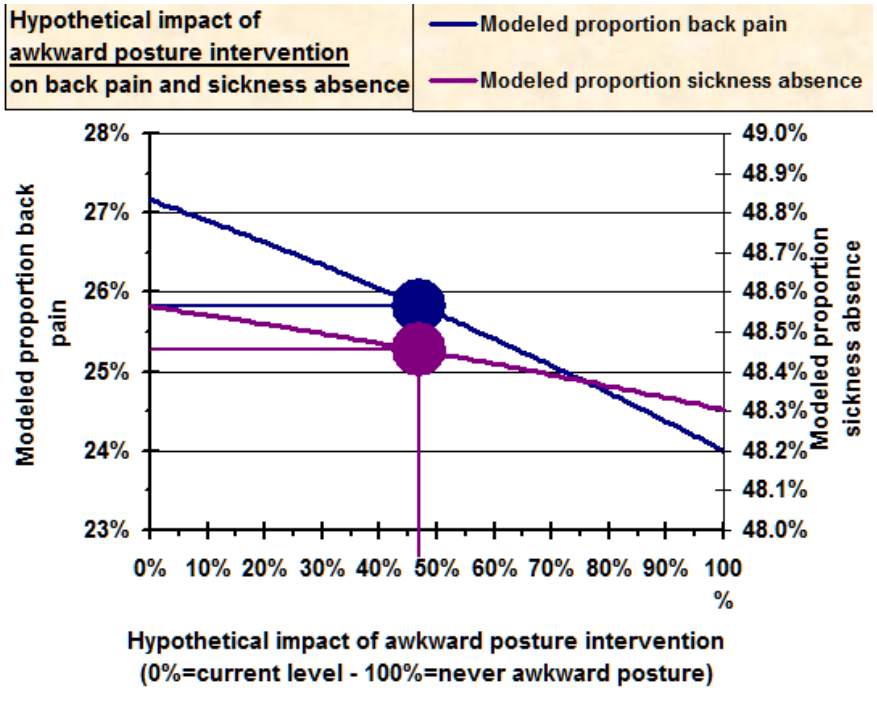




Intervention with a strength of 47%

- Exposure to awkward posture 20%
- Back pain 25.8%
- Sickness absence 48.5%





Conclusion

- With regard to the example: to achieve a substantial decrease in the occurrence of back pain or sickness absence, an intervention is needed that will result in a high decrease in exposure

- With regard to the practicability of the tool: it is a useful tool to show what amount of exposure change is needed to achieve a substantial effect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Thanks!!