Achtergronddocument

Bij registratierichtlijn S001 Liesbreuk (Hernia Inguinalis)

CAS-code: S631
ICD-10-codes: K40 – hernia inguinalis

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Bij registratierichtlijn S001 Liesbreuk (Hernia Inguinalis)

CAS-code: S631
ICD-10-codes: K40 – hernia inguinalis

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Juli 2019, Nederlands Centrum voor Beroepsziekten, www.beroepsziekten.nl

Dit achtergronddocument bij de registratierichtlijn wordt beschreven aan de hand van het 6-stappenplan voor melden van beroepsziekten bij het Nederlands Centrum voor Beroepsziekten (NCvB).

Het 6-stappenplan van het NCvB luidt:

Stap 1. Vaststellen van de aandoening/ziekte
Stap 2. Vaststellen van de relatie met werk
Stap 3. Vaststellen van de aard en het niveau van de oorzakelijke blootstelling
Stap 4. Nagaan van andere mogelijkheden en de rol van de individuele gevoeligheid
Stap 5. Concluderen en melden
Stap 6. Preventieve maatregelen en interventies inzetten en evalueren

Naast de informatie die beschreven is in de registratierichtlijn bevat dit achtergronddocument ook de referenties naar de medische literatuur die is gebruikt.

Inleiding
Een liesbreuk of hernia inguinalis is een aandoening die bestaat uit een uitstulping van het buikvlies in de liesstreek, waardoor organen die normaal in de buikholte zitten zoals de dunne darm uit gaan puilen. Er zijn diverse soorten liesbreuken te onderscheiden, onder andere afhankelijk van de plaats ('breukpoort') waar de inhoud van de buikholte uit gaat puilen en bij volwassenen zijn dit veelal:

- de directe (mediaal, via de achterwand van het lieskanaal) liesbreuk, achter de arteria epigastria inferior langs;
- de indirecte liesbreuk (lateraal door de anulus inguinalis in het lieskanaal richting scrotum), vóór de arteria epigastria inferior langs (Friedbichler e.a. 2009).

Een liesbreuk kan pijn doen, knellen, branden of steken. Bij klachten wordt de buikwand operatief hersteld. In Nederland gebeurde dat 50.015 maal in 2015: de helft van de patiënten was in de leeftijd van 20-65 jaar namelijk 25.175 gevallen (50%) en de 1-jaars-incidentie van deze operatie is het hoogst in de leeftijdsgroep 45-65 jaar met 35% (CBS Statline 2019). Mannen hebben tijdens hun

leven 27% kans op een liesbreuk. Bij vrouwen is de kans een stuk lager: 3% (Zorgkaart Nederland 2015).

Stap 1. Vaststelling van de aandoening

De diagnose liesbreuk wordt bij volwassenen ouder dan 18 jaar gesteld op basis van anamnese en lichamelijk onderzoek (Nederlandse Vereniging voor Heelkunde 2003):

- Bij de anamnese wordt aandacht besteed aan: zwelling lies, rechts/links, aard klachten (pijn), duur klachten, contralaterale lies zwelling, beklemmingverschijnselen, reponibel, eerdere liesoperaties;
- Bij lichamelijk onderzoek wordt aandacht besteed aan: zwelling lies (boven het ligament van Poupart), operatielitteken liesregio, contralaterale lies, beklemmingsverschijnselen, reponibel, testes, NB Het onderscheid lateraal/mediaal is onbetrouwbaar op basis van lichamelijk onderzoek;
- Differentiaaldiagnoses zijn femoraalbreuk, lymfklierzwelling, aneurysma, varix vena saphena magna, wekedelentumor, abces, en corpus alienum (gossipyboma);
- Aanvullende diagnostiek zoals herniografie, MRI, echo of laparoscopie is zelden nodig.

Stap 2. Vaststellen van de relatie met werk

De drie criteria die experts hanteren om de relatie met werk vast te stellen van een ziekte of aandoening zijn de grootte van de bewezen risicofactoren uit de medische literatuur, een tijdsrelatie en de biologische plausibiliteit (Verbeek 2012). Voor een populatie werknemers met een bepaalde blootstelling of een bepaalde beroepsgroep wordt een ziekte of aandoening veelal aangemerkt als beroepsziekte als de etiologische fractie door risico's in het werk ≥50% is. Het relatief risico is dan twee of groter. Een etiologische fractie van 50% impliceert dat onder de zieke blootgestelde personen 50% van de ziekten te wijten is aan de blootstelling. Op individueel niveau dient de bedrijfsarts te bepalen of liesbreuk bij de werknemer in overwegende mate wordt veroorzaakt door het werk op basis van op populatieniveau verkregen evidence-based risicofactoren. Bij het vaststellen of er een oorzakelijk verband met werk zou kunnen zijn voor een individuele werknemer is zoals gezegd ook de tijdsrelatie van belang (klachten ontstaan nadat met het huidige werk is begonnen, verergering van klachten door specifieke taken of na drukke perioden, klachten zijn minder na vrije dagen of vakantie of de invoering van preventieve maatregelen) en of de risicofactor in werk ook in lijn is met het veronderstelde pathofysiologische mechanisme voor de aandoening of ziekte, denk bijvoorbeeld aan een voldoende latentieperiode of blootstellingsduur of 'overbelasting van bepaalde structuren zonder voldoende herstel'.

Stap 3. Vaststellen van aard en niveau van de oorzakelijke blootstelling

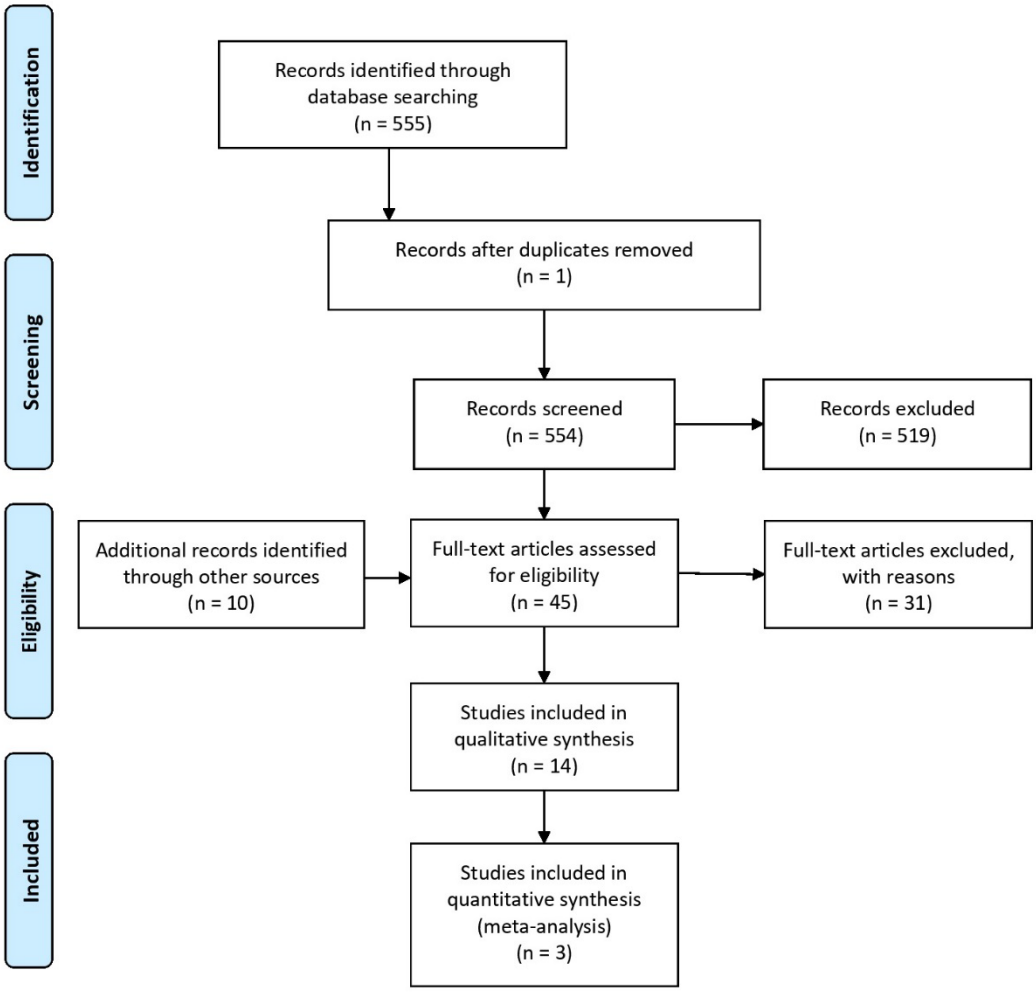
De werkgerelateerde risicofactoren zijn gebaseerd op een systematische literatuurstudie uitgevoerd in PubMed tot en met 14 mei 2018 (Hondebrink 2018). De vraagstelling was 'Wat zijn werkgerelateerde risicofactoren voor een liesbreuk bij werkenden?'. De zoekstrategie staat in tabel 1. Twee auteurs (DH en PK) beoordeelden onafhankelijk van elkaar alle artikelen op basis van de titel

en samenvattingen met behulp van de website 'rayyan.qcri.org'. Om aan de inclusiecriteria te voldoen, moesten de studies rapporteren over werkgerelateerde risicofactoren en over door een arts vastgestelde liesbreuken bij werkende patiënten. Wanneer consensus was bereikt, werden de volledige artikelen gelezen en opnieuw onafhankelijk beoordeeld aan de hand van de genoemde inclusiecriteria.

Tabel 1. Zoekstrategie PubMed

Kernbegrip	Zoektermen PubMed
Werkende	((adult[mesh]) OR (adult[tiab]) OR (middle aged[mesh]) OR (middle aged[tiab]))
Liesbreuk	((inguinal hernia[mesh]) OR (inguinal hernia[tiab]))
Risicofactoren in werk	((occupational disease*[mesh]) OR (occupational disease*[tiab]) OR (risk factor*[mesh]) OR (risk factor*[tiab]) OR (work-related[mesh]) OR (work-related[tiab]) OR (etiology[mesh]) OR (etiology[tiab]))

Na consensus werd de literatuurlijst van de geïncludeerde artikelen ook gecontroleerd op mogelijk relevante studies. Daarnaast is ook gekeken of de aanvulling op de literatuurstudie van Svendsen e.a. (2013) uit het proefschrift van Vad (2018) met een zelfde vraagstelling over de periode 3 november 2011 tot en met 1 mei 2018 nog extra artikelen opleverde. Deze zoekstrategie resulteerde uiteindelijk in 14 artikelen over een relatie met werk (Figuur 1). De drie studies die konden worden gebruikt in een meta-analyse en zijn door twee auteurs (DH, PK) op kwaliteit beoordeeld met het beoordelingsinstrument van Van der Molen e.a. (2012) (Bijlage I). Dit is ook gebeurd voor de twee studies die rapporteerden over de blootstelling in termen van werkgerelateerde activiteiten (Tabel 2). Bij meer dan 11 punten scoorden de studies een laag risico op vertekening (bias). De relevante kenmerken uit de 14 studies zijn weergegeven in bijlage II (Hondebrink 2018). Tot slot is ook GRADE toegepast om de mate van zekerheid over de uitkomst te graderen in termen van zeer laag, laag, redelijk en hoog (Bijlage III, http://dutchgradenetwork.org). Deze beoordeling wordt vertaald in respectievelijk ‘weinig, beperkt, redelijk of veel vertrouwen in de schatting van het gunstige of ongunstige effect van de risicofactor op het krijgen van een liesbreuk.’



Figuur 1. Stroomdiagram van de inclusie van de artikelen

De 14 studies zijn verdeeld naar de manier waarop deze de werkgerelateerde fysieke risicofactoren beschreven namelijk aan de hand van de economische sector of beroep, de mate van fysieke belasting of in termen van de risicovolle werkgerelateerde activiteiten zoals staan, lopen en tillen.

Tabel 2. De kwaliteitsbeoordeling van de studies uit de meta-analyse en de werkgerelateerde activiteiten. Alle vijf studies hadden een laag risico op vertekening

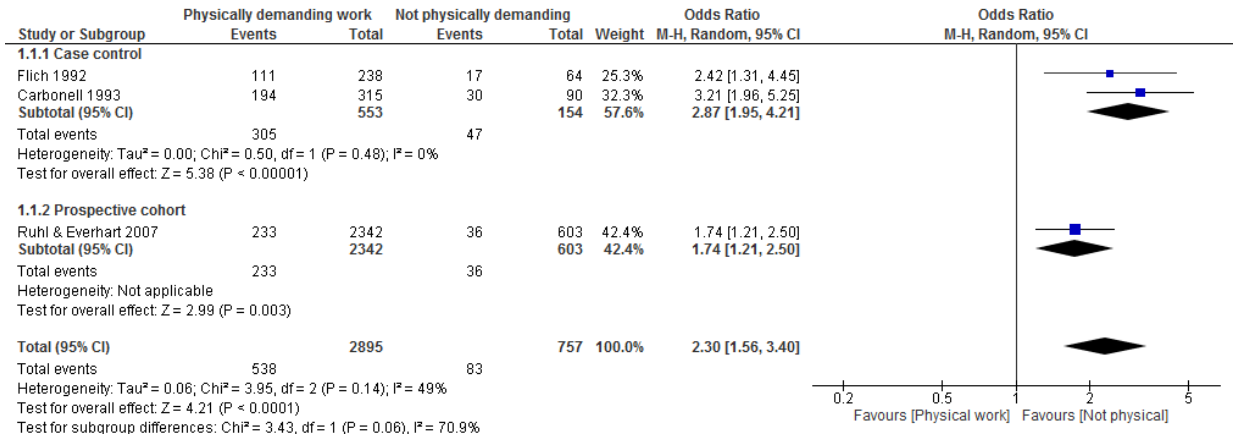
	Quality assessment scores																
Author	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total (16)
Carbonell et al. 1993	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	15
Flich et al. 1992	+	+	+	+	+	+	+	+	-	-	+	+	+	+	+	+	14
Ruhl & Everhart 2007	+	-	+	-	+	-	+	+	+	+	+	+	-	+	+	+	12
Vad et al. 2012	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	15
Vad et al. 2017	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	15
Total (5)	5	3	5	4	5	4	5	5	4	3	5	5	3	5	5	5	

Economische sector of beroep

Een cross-sectionele studie (Kang 1999) noemde onder andere de volgende economische sectoren en beroepen met een verhoogde kans op het hebben van een liesbreuk in vergelijking met de totale mannelijke populatie werkenden: bouw, productie, groothandel, (hand)arbeiders, machinebedieners, assemblagepersoneel, (onderhoud)reparateurs, en transport- en logistiekmedewerkers.

Fysieke belasting

Twee case-reports, vijf case-control studies en drie prospectieve cohort studies beschreven de risicofactor fysieke belasting (Hondebrink 2018). Twee case-control studies bij mannen en vrouwen (Flich e.a. 1992, Carbonell e.a. 1993) en een prospectieve cohortstudie bij mannen (Ruhl & Everhart 2006), allen van hoge kwaliteit, konden worden gecombineerd in een meta-analyse en toonden aan dat zware fysieke belasting in werk de kans op een liesbreuk verhoogt met een gepoolde OR van 2,30 (1,56-3,40) (Figuur 2). Zware fysieke belasting was gebaseerd op een zelf-rapportage over de mate van inspanning tijdens het werk gecategoriseerd in vier categorieën (geen, licht, gemiddeld, zwaar, Flich e.a. 1992), een zwaartescore van 1 tot en met 10 berekend op basis van een zelf-rapportage over onder andere het aantal dagen per week dat zwaar werk wordt verricht, het gewicht van de eventueel te tillen objecten en of het werk staan of zittend werd verricht (Carbonell e.a. 1993), en een zelf-rapportage over niet-recreatieve activiteiten in drie categorieën laag actief, matig actief, en hoog actief (Ruhl & Everhart 2006). Bij het beoordelen van de mate van zekerheid met GRADE is de conclusie dat ‘er beperkt vertrouwen is in de schatting van het ongunstige effect van zware fysieke belasting op het krijgen van een liesbreuk.’ (Bijlage III, pagina 38).



Figuur 2. Forest plot met het gewogen risico van fysiek zwaar werk voor een liesbreuk gebaseerd op drie studies van hoge kwaliteit

Werkgerelateerde activiteiten
Door Sanjay & Woodward (2007) en Vad e.a. (2012, 2017) zijn de werkgerelateerde activiteiten staan/lopen en tillen onderzocht. Door het ontbreken van een controlegroep, konden alleen de studies van Vad (2012, 2017) worden gebruikt. Deze beschrijven het risico op een liesbreuk bij mannen. Zij vonden in de eerste plaats dat deze werkgerelateerde activiteiten alleen een risicofactor zijn voor een laterale (indirecte) liesbreuk en niet voor een mediale (directe). Dit bleek vooral te gelden voor werk dat gekenmerkt werd door meer dan zes uur per dag staan of lopen (HR =1,45 95% Betrouwbaarheidsinterval 1,12-1,88, gecorrigeerd voor onder andere leeftijd, BMI, lichamelijke activiteit in de vrije tijd, en roken) en voor tillen van meer dan 4000 kg per dag (OR=1,32 95% Betrouwbaarheidsinterval 1,27-1,38, gecorrigeerd voor leeftijd, sociaal economische positie en regio in het land) (Bijlage III, pagina 38). Bij het beoordelen van de mate van zekerheid met GRADE is de conclusie dat ‘er matig vertrouwen is in de schatting van het ongunstige effect van meer dan zes uur per dag staan of lopen en voor tillen van meer dan 4000 kg per dag op het krijgen van een liesbreuk’ (Bijlage III, pagina 38).

Stap 4. Nagaan van andere mogelijkheden en de rol van de individuele gevoeligheid

Persoonsgebonden factoren die het risico op een liesbreuk vergroten bij werkenden zijn oudere leeftijd (>40 jaar) (Ruhl & Everhart 2007, Vad e.a. 2012, 2017) en man zijn (Ruhl & Everhart 2007, Vad e.a. 2012, 2017). Het hebben overgewicht en/of obesitas lijkt het risico te verlagen (Ruhl & Everhart 2007, Vad e.a. 2017). Roken en lichamelijke activiteit in de vrije tijd resulteerden niet in een grotere of kleine kans op een liesbreuk (Vad e.a. 2017).

Stap 5. Concluderen en melden

Er is bewijs voor een liesbreuk als beroepsziekte wanneer deze aanwezig is bij een mannelijke of vrouwelijke werkende die enige jaren zwaar lichamelijk werk heeft verricht. De mate van zekerheid is redelijk tot hoog als het ook een mannelijk werkende is, die gediagnosticeerd is met een laterale (indirecte) liesbreuk en wiens werk bestaat uit meer dan 6 uur per dag staan of lopen en/of meer dan 4000 kg tillen.

Stap 6. Preventieve maatregelen en interventies inzetten en evalueren

Maximaal 31% van de liesbreuken treedt theoretisch niet op als de werkbelasting wordt verlaagd naar minder dan 4 uur per dag staan of lopen berekende Vad (2017). Zij stelt dat wanneer de tijdsduur staan of lopen verminderd kan worden tot maximaal 4 uur het risico op een werkgerelateerde liesbreuk niet meer verhoogd aanwezig is. Ook het verminderen van de tilbelasting per dag verkleint theoretisch dit risico, bij voorkeur tot maximaal 1000 kg (Vad 2018). Specifieke studies naar het effect van preventieve maatregelen in werk op het krijgen van een liesbreuk zijn niet gevonden. De oplossing dient dus gevonden te worden in effectieve oplossingen om langdurig staan en/of zwaar tillen te verminderen. Effectieve oplossingen voor tillen zijn beschreven in de multidisciplinaire richtlijn ‘Vermindering van tilbelasting om rugklachten te voorkómen’ (Kuijer e.a. 2014): https://aoemj.biomedcentral.com/articles/10.1186/2052-4374-26-16
Voor langdurig staan bestaat op dit moment geen vergelijkbare richtlijn.

Voorbeelden van oplossingen uit de praktijk die effectief kunnen zijn, zijn beschreven in de arbocatalogi voor diverse sectoren en branches: https://www.arboportaal.nl/externe-bronnen/arbocatalogi.

Ook de volgende twee websites kunnen van nut zijn:

https://www.arboportaal.nl/onderwerpen/statische-werkhouding-staan
https://www.arboportaal.nl/onderwerpen/tillen-en-dragen

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Bijlage I Beoordelingsformulier kwaliteit van artikelen (Van der Molen e.a. 2017)

ID:

Study population		
1 Study groups (exposed and unexposed) are clearly defined	Positive if at least 2 of the following 3 items in both groups were reported at baseline: age, gender; sport/leisure time exposure	☐ Positive ☐ Negative ☐ Unclear
2 Participation ≥70%	Positive if the participation of both the exposed and unexposed groups was ≥70%	☐ Positive ☐ Negative ☐ Unclear
3 Number of cases ≥50	Positive if the total number of cases was ≥50	☐ Positive ☐ Negative ☐ Unclear
Assessment of exposure		
4 Exposure definition	Positive if the exposure was clearly defined Definition included at least two of the three	☐ Positive

	aspects(duration, frequency, intensity) for instance cumulative exposure over the subject's working life: duration X intensity	☐ Negative ☐ Unclear
5 Assessment of exposure	Positive if the assessment of exposure was described Exposure (risk factors, independent variables) were measured using known "gold standard" (define specific for the exposure) like direct observations, instrumented measurements for WBV or goniometers Unclear, negative The authors did not validate the methods to measure exposure (risk factors, independent variables)	☐ Positive ☐ Negative ☐ Unclear
6 Blind for outcome status	Positive if the exposure was assessed by an independent person and not based on self-report	☐ Positive ☐ Negative ☐ Unclear
Assessment of outcome (specific disorder)		
7 Outcome definition	Positive if the outcome was clearly defined Case definition provided	☐ Positive ☐ Negative ☐ Unclear
8 Assessment method	Positive if the method of assessment was suitable Clinically defined disorder	☐ Positive ☐ Negative ☐ Unclear

9 Blind for exposure status	Positive if the outcome was measured without knowledge of the exposure status by an independent person, thus not based on self-reported symptoms	☐ Positive ☐ Negative ☐ Unclear
Study Design		
10 Prospective design or a retrospective cohort	Positive if the study design was prospective or a retrospective cohort	☐ Positive ☐ Negative ☐ Unclear ☐ Not applicable
11 Inclusion and exclusion criteria	Positive if inclusion and exclusion criteria were described	☐ Positive ☐ Negative ☐ Unclear
12 Follow-up period ≥1 year	Positive if the follow-up period was ≥1 year	☐ Positive ☐ Negative ☐ Unclear
13 Information on study completers versus withdrawals	Positive if demographic information was given for completers and withdrawals	☐ Positive ☐ Negative

		☐ Unclear
Analysis and data presentation		
14 Data presentation	Positive if risk estimates were presented or when raw data were given that allow the calculation of risk estimates, such as: odds or prevalence ratios or relative risks	☐ Positive ☐ Negative ☐ Unclear
15 Consideration of confounders	Positive if the confounders that were considered were described	☐ Positive ☐ Negative ☐ Unclear
16 Control for confounding	Positive if the method used to control for confounding was described.	☐ Positive ☐ Negative ☐ Unclear

Bijlage II Data-extractietabel van de geïncludeerde studies (Hondebrink 2018)

Author, year, study design and quality score	Population	Risk factor	Exposure vs. Reference)	Risk estimate
Industry/type of work				
Seong-Kyu Kang 1999 Cross-sectional study (4/16)	The injury and illness data are obtained from Occupational Safety and Health Administration's (OSHA) 200 logs and supplementary records that establishments maintain throughout the reference year [U.S. Department of Labor, 1994]. The survey excludes self-employed people, farms with fewer than 11 employees, private households, and Federal, State, and local government agencies. Data for mines and railroads are provided to the BLS by the Department of	Working in a certain industry or having a certain type of job.	Incidence rate: Incidence per 10000 workers. Rate ratio: Hernia incidence rate (IR) for each occupation divided by the hernia incidence rate of total workers (reference)	*Hernia by industry* Total (reference)(n males, n cases): • 51246000, 30791 IR = 6.0 Rate ratio (95% CI) = 1.00 (0.82-1.18) Agriculture: • 1370000, 516 IR = 3.8 Rate ratio = 0.63 Mining: • 549000, 271

	Labor's Mine Safety and Health Administration and the Department of Transportation's Federal Railroad Administration and are reported with the Annual Survey results. N = 51246000 male workers. There were 30791 cases.			IR = 4.9 Rate ratio = 0.82 Construction: • 4908000, 4129 IR = 8.4 Rate ratio = 1.40 Manufacturing: • 13337000, 11810 IR = 8.9 Rate ratio = 1.47 Transportation: • 4745000, 2391 IR = 5.0 Rate ratio = 0.84 Wholesale trade: • 3074000, 3294

				IR = 10.7 Rate ratio = 1.78 Retail trade: • 9379000, 4681 IR = 5.0 Rate ratio = 0.83 Finance and insurance • 2819000, 620 IR = 2.2 Rate ratio = 0.37 Service • 11047000, 3080 IR = 2.8 Rate ratio = 0.46

				Hernia by occupation Handlers, equipment cleaners, helpers and laborers (n males, n cases): • 3785000, 5661 IR = 15.0 Rate ratio (95% CI) = 2.47 (2.14-2.80) Machine operators and tenders: • 2966000, 3824 IR = 12.9 Rate ratio (95% CI) = 2.13 (1.81-2.44) Fabricators, assemblers and handworking occupations: • 1290000, 1585, 12.3 IR = 12.3 Rate ratio (95% CI) = 2.03 (1.69-2.37)

				Mechanics and repairers: • 3486000, 3623 IR = 10.4 Rate ratio (95% CI) = 1.72 (1.43-2.00) Transportation and material moving equipment occupations: • 3900000, 3410, 8.7, 1.44 (1.18-1.71) IR = 8.7 Rate ratio (95% CI) = 1.44 (1.18-1.71) Production inspectors, testers, samplers and weighers: • 340000, 271, 8.0, 1.32 (0.95-1.69) IR = 8.0 Rate ratio (95% CI) = 1.32 (0.95-1.69) Extractive occupations: • 138000, 106 IR = 7.7

				Rate ratio (95% CI) = 1.21 (0.83-1.71) Construction trade: • 3557000, 2735 IR = 7.7 Rate ratio (95% CI) = 1.27 (1.02-1.52) Precision product occupations: • 2692000, 1716, 6.4 IR = 6.4 Rate ratio (95% CI) = 1.05 (0.81-1.30) Administrative support: • 2816000, 1533, 5.4 IR = 5.4 Rate ratio (95% CI) = 0.90 (0.67-1.12) Service except private household and protective services: • 4141000, 2201, 5.3

				IR = 5.3 Rate ratio (95% CI) = 0.88 (0.66-1.09) Agricultural occupations: • 1464000, 689, 4.7 IR = 4.7 Rate ratio (95% CI) = 0.78 (0.54-1.02) Technicians and related support occupations: • 1478000, 516 IR = 3.5 Rate ratio (95% CI) = 0.58 (0.36-0.79) Protective services: • 575000, 160 IR = 2.8 Rate ratio (95% CI) = 0.46 (0.22-0.70) Sales occupations:

				• 6385000, 1584 IR = 2.5 Rate ratio (95% CI) = 0.41 (0.26-0.56) Professional specialty occupations: • 5225000, 617, 1.2, 0.20 (0.07-0.32) IR = 1.2 Rate ratio (95% CI) = 0.20 (0.07-0.32) Executive, administrative and specialty occupations: • 6984000, 570 IR = 0.8 Rate ratio (95% CI) = 0.13 (0.03-0.24) *Top 10 high risk occupations among 40 major occupations* Laborers, nonconstruction (n males, n

				cases): • 919000, 2495 IR = 27.2 Rate ratio (95% CI) = 4.52 (4.04-5.00) Miscellaneous machine operators: • 745000, 1271 IR = 17.1 Rate ratio (95% CI) = 2.84 (2.42-3.26) Plumbers and pipefitters: • 388000, 630 IR = 16.2 Rate ratio (95% CI) = 2.70 (2.19-3.21) Construction laborers: • 650000, 915 IR = 14.1 Rate ratio (95% CI) = 2.34 (1.94-2.74)

				Freight, stock, material handlers: • 607000, 818 IR = 13.5 Rate ratio (95% CI) = 2.24 (1.85-2.64) Welders and cutters: • 517000, 674 IR = 13.0 Rate ratio (95% CI) = 2.17 (1.77-2.57) Assemblers: • 685000, 843 IR = 12.3 Rate ratio (95% CI) = 2.05 (1.67-2.43) Shipping and receiving clerks: • 404000, 495 IR = 12.3 Rate ratio (95% CI) = 2.04 (1.63-2.45)

				Truck drivers: • 2328000, 2451 IR = 10.5 Rate ratio (95% CI) = 1.75 (1.45-2.05) Janitors and cleaners: • 921000, 901 IR = 9.8 Rate ratio (95% CI) = 1.63 (1.29-1.96)
Physically demanding work				
Ashindoitiang, *et al.* 2012 Case-control study (10/16)	All male patients aged 18 years and above who presented with primary inguinal hernia at the general surgical clinic of Ikorodu General Hospital between April 2009 and March 2011 were accepted into the study as cases.	Strenuous activities are classified as vigorous (metabolic equivalent of task (MET) > 6.0). Non-strenuous activities are classified as moderate (metabolic equivalent of task (MET) between 3.0 and 6.0).	Strenuous activities present vs. Absent (reference).	Strenuous activities absent (reference) (n = cases, controls): • 86 • 160 Strenuous activities present (n = cases, controls): • 116 • 42

	N = 404 male patients • Case group: N = 202, age 16-80. • Control group: N = 202, age 17-83.		Strenuous activities present vs. absent (reference), adjusted for: chronic cough, straining during urination/defecation, ascites/abdominal mass, family history of inguinal hernia, obesity and smoking.	Univariate OR (95% CI): ○ 5.138 (3.331-7.975) Multivariate OR (95% CI): ○ 5.988 (3.667-9.777) *Type of hernia* Strenuous activities present (n = indirect (%), direct (%)): • 69 (52%) • 47 (67%) Strenuous activities absent (n = indirect (%), direct (%)): • 63 (48%) • 23 (33%)

Carbonell, et al. 1993 Case-control study (11/16)	The cases were 290 patients operated on for inguinal (direct and indirect) and femoral hernias from 1987-1989 at the hospital Peset Aleixandre. Controls were selected randomly from the same population. N = 580 people. Case group: N = 290, age 21-86. • 228 ♂ • 62 ♀ Control group: N = 290, age 21-90. • 228 ♂ • 62 ♀	An effort score of 1-10, for a maximum of four different activities or jobs before the hernia developed, was calculated using the following variables: • Sedentary work (score 1) or standing still (score 2). • Number of hours/day spent standing. • Number of times heavy objects were lifted. • Weight of these objects (kg). • Number of days/week of physical exertion. • Number of days/week doing labourers' work • Number of years spent doing each activity. • Physical exertion only at work (if yes score 1, if not score 0) • Physical exertion only at play (same as above). • Physical exertion at work and at play (same as above).	An effort score of 1 (reference) was compared to higher effort scores across different jobs.	*Risk factors for inguinal hernia* Effort needed for first job (RR, 95% CI): • RR = 2.92 (3.667-9.777) P < 0.01 Effort needed for second job (RR, 95% CI): • RR = 2.47 (1.70-3.58) P = 0.09 Effort needed for third job (RR, 95% CI): • RR = 3.22 (1.64-6.31) P = 0.71 Effort needed for fourth job (RR, 95% CI): • RR = 1.71 (0.41-7.03) P = 0.99

		The effort score ranged from 1 to 10, after logarithmically converting the multiplied value of each variable.		
Dickerman, *et al.* 2004 Case-report study (4/16)	N = 1, a 42-year old male powerlifter who was seen for complaints of excessive oesophageal reflux, an umbilical hernia and bilateral inguinal hernias.	Wearing a powerlifting belt, since the inguinal hernias occurred after the umbilical hernia while the patient was wearing a belt.	N/A	According to the study, there is no doubt the subject's competitive powerlifting career predisposed him to hernia formation. Even though no reports on an increased incidence of inguinal or umbilical hernias developing in power athletes, they previously established the increased incidence of hiatal hernias in young powerlifters and thus propose that this case of multiple hernias is likely the result of a pressure-overload syndrome that can occur in competitive powerlifters.
Flich, et al. 1992 Case-control study (13/16)	The 128 cases were all patients with inguinal hernias treated in 1986 in the hospital (the General Hospital of Valencia). All were in-patients for surgery. The 174 controls were selected from the same geographic area. They were randomly selected from the total population	Physical activity, including intensity and length of time in activity, was split into four categories. The inclusion of an effort category (each person can present different categories in the course of	Cases and controls (reference) in different effort categories (high + medium and no + light) were compared to each other.	*Effort intensity* Effort high + medium (n = cases, controls): • 111 • 127 Effort no + light (n = cases, controls): • 17 • 47

	tabulated at the health care centre. N = 302 cases and controls N = 128 cases (mean age 50.23): • 107 ♂ • 21 ♀ N = 174 controls (mean age 50.82): • 151♂ • 23♀	his/her life), depended on the type of work carried out for the longest period of time. The categories are as follows: 1) No effort, activities involving no effort and sedentary work were included; 2) light, standing work involving occasional lifting of not too heavy weights; 3) medium, when weight was lifted more frequently; 4) high, when the effort was daily.	Cases and controls (reference) in different effort categories (high and no) were compared to each other. Cases and controls of different years of effort (1-10, 20-39 and 40-69) categories were compared to cases	OR (95% CI*) = 2.41 (1.31-4.45) x^2/P = < 0.05 Effort high (n = cases, controls): • 37 • 16 Effort no (n = cases, controls): • 1 • 10 OR (95% CI*) = 23.12 (2.73-196.09) x^2/P = < 0.0001 *Time of exposure to effort* Years of effort: 0 (n = cases, controls): • 1 • 10

			and control of the years of effort = 0 category (reference)	OR = 1.00 Years of effort: 1-10: • 12 • 49 OR (95% CI*) = 2.45 (0.29-21.03) Years of effort: 20-39: • 40 • 50 OR (95% CI*) = 8.00 (0.98-65.15) Years of effort: 40-69: • 75 • 65 OR (95% CI*) = 11.54 (1.44-92.57) P ≤ 0.01 *Categories and time of exposure to effort*

			Cases and controls in the effort category of light + medium and high were categorized in different groups of years of effort (1-19, 29-39 and 40-69). These were compared to the years of effort = 0 (reference)	Effort light + medium Years of effort: 1-19 (n = cases, controls): • 22 • 55 OR (95% CI*)= 4.00 (0.48-33.13) Years of effort: 29-39: • 26 • 33 OR (95% CI*)= 7.87 (0.95-65.57) Years of effort: 40-69: • 41 • 36 OR (95% CI*)= 11.38 (1.39-93.36) x^2/P =<0.001 Effort high

				Years of effort: 1-19 (n = cases, controls): • 19 • 14 OR (95% CI*)= 13.57 (1.55-118.68) Years of effort: 29-39: • 13 • 2 OR (95% CI*)= 65.00 (5.14-822.63) Years of effort: 40-69: • 5 • 0 OR = Not available * = self-calculated
Lau, *et al.* 2007 Case-control	Between January 2002 and January 2004, male patients who presented with primary inguinal hernia at the general surgical or	Physical activity was quantified in terms of 3 dimensions: (1) physical activity at work,	Work and total activity indexes of cases and controls (reference) were	Work activity index (range): ○ Cases = 2.8 (2.3-3.3) ○ Controls = 2.7 (2.2-3.2)

study (10/16)	hernia specialist clinic, University of Hong Kong Medical Center, were recruited as cases. N = 1418 male subjects • Case group: N = 709 cases with primary inguinal hernia. Age 65 ± 13 • Control group: N = 709 age matched controls.	(2) sport activity during leisure time, (3) physical activity during leisure time excluding sport. Subjects responded to a 5-point scale with descriptions ranging from never (point value 1) to always (point value 5). For each category, high activity was represented by a maximum score of 5 and low activity by a minimum score of 1. The indices of physical activity, including scores for the work index, sport index, and leisure index were calculated as the sum of intensity multiplied by time engagement. A total activity index was then derived by summing up these 3 values.	compared.	P = 0.03 Total activity index (range): ○ Cases = 7.7 (7.1-8.3) ○ Controls = 7.4 (6.8-8.0) P = 0.01
Liem, et al. 1997	All incident female cases of inguinal hernia in six participating	For each category (work, sports activity and leisure time) high	The present work activity index,	Present work activity index (range) • Cases = 2.9 (2.6-3.2)

Case-control study (11/16)	hospitals in the Netherlands, between January 1994 and November 1995 were collected and registered. Controls were selected from females who visited the outpatient surgical clinic for excision of common benign tumours of the skin unlikely to confound a comparative analysis. N = 197 female subjects, age 20-80 • Case group: n = 72 • Control group: n = 125	activity was represented by the maximum score of 5, and low activity by the minimum score of 1. A total activity index was calculated by adding the three separate scores.	duration of present work and the present leisure-time activity index of cases and controls (reference) were compared. Also, duration of present work x present work activity index was compared between cases and controls (reference). The past work activity index,	• Controls = 2.9 (2.6-3.1) P = 0.6 Duration present work in years: • Cases = 26 (17-43) • Controls = 30 (12-43) P = 1.0 Duration x present work activity: • Cases = 86.9 (43.6-118.1) • Controls = 86.6 (36.3-123.5) P = 1.0 Present leisure-time activity index: • Cases = 2.9 (2.7-3.3) • Controls = 3.0 (2.6-3.3) P = 1.0 Present total index: • Cases = 8.0 (7.2-8.5) • Controls = 8.1 (7.3-9.0) P = 0.15

		Work activity in the past was estimated with four categories (sedentary, standing, labor, heavy labor) using examples for both activity level and job type.	duration of past work and the past leisure-time activity index of cases and controls (reference) were compared. Also, duration of past work x past work activity index was compared between cases and controls (reference).	Past work activity index (range): • Cases = 1 (0-3) • Controls = 2 (0-3) P = 0.9 Duration past work in years: • Cases = 5 (0-11) • Controls = 6 (0-10) P = 0.5 Duration x past work activity: • Cases = 6 (0-24) • Controls = 12 (0-25) P = 0.4 Past leisure-time activity index: • Cases = 8 (6-9) • Controls = 8 (6-9) P = 0.8

Pathak and Poston 2006 Prospective cohort study (7/16)	Questionnaires were issued to a consecutive cohort of new patients presenting with an abdominal wall hernia. Data were collected from a single cohort study of patients presenting to a general surgical clinic at an urban general hospital over a 6-month period (January 2003 to June 2003).	Single strenuous or traumatic event.	All cases were clinically diagnosed. Single strenuous or traumatic events were compared to non-strenuous events.	From 133 cases 119 (89%) hernias had been gradual or insidious in onset. There were 14 patients (11%) with a convincing history correlating the symptoms to a single strenuous event. 5 patients of those 14 had no risk factors. One of those 14 stated that they had a strenuous job which involved repetitive heavy lifting or straining. Three patients stated that they believed that their hernias had developed due to strenuous exercise and stretching. Two patients claimed that coughing precipitated their hernia, and two said that their hernia came on suddenly but could not recall what they were doing at the time. The remainder believed that the aetiology of their hernias was related to a strenuous event but were unable to identify specifically the causal act. None of these 6 undertook a job that included strenuous physical labouring.
Ruhl and Everhart 2007	NHANES I included interview, examination, and laboratory data collected from a national probability sample of	Participants were asked about nonrecreational activity (inactive, moderately active, very active).	Nonrecreational activity was divided in three categories: low (reference),	*Nonrecreational physical activity* Low (n male participants, n cases, HR (95%

Prospective cohort study (11/16)	the civilian, noninstitutionalized US population. The NHANES I Epidemiologic Follow-up Study was a longitudinal study of the 14,407 NHANES I participants aged 25–74 years who had been medically examined. N = 13452 persons remaining for analysis, age 25-74. • 5316 ♂ • 8136 ♀		moderate and high. HR was adjusted for age.	CI)): • 603 • 36 HR = 1.0 Moderate: • 2366 • 231 HR = 1.3 (0.92-1.9) High: • 2342 • 233 HR = 1.3 (0.90-1.8) P for trend: 0.42
Smith, et al. 1996	Consecutive patients presenting with inguinal hernia over a 6-month period were entered into the study.	Single strenuous event.	All cases were clinically diagnosed. Single strenuous or traumatic events	From 129 cases 120 (93%) hernias had been gradual or insidious in onset. In 9 patients (7%) there was a convincing history suggesting an association between

Prospective cohort study (7/16)	N = 129 patients, age 20-89. • 122♂ • 7♀		were compared to non-strenuous events.	a particular muscle strain, groin pain and the discovery of a groin swelling. None of these had previously had a hernia repair or appendectomy. Four of the nine patients had a strenuous job, of whom three claimed that the incident had occurred at work. None had any associated medical problems such as chronic chest disease or bladder outflow obstruction. In one patient the diagnosis was made by a doctor within a few days, the remainder being diagnosed between 1 week and 4 years later, median 3.5 weeks. At operation five of these patients had a direct hernia, three had indirect sacs, and one has not had surgery. One patient described a fall which seemed to precipitate the hernia, while the remainder described lifting strains either at home or work.
Snyder and Kearney 2002	N = 1, a 41-year old male flight surgeon.	Performing an anti-G straining manoeuvre during high Gz manoeuvres.	N/A	Acute inguinal herniation may occur during high Gz flight with aggressive anti-G straining manoeuvre.

Case report study (6/16)				
Lifting				
Sanjay and Woodward 2007 Retrospective cohort study (7/16)	Patients who underwent elective inguinal hernia repair under the care of one surgeon, between 1995 and 2004. Gradual onset: n = 164, aged 20-87 • 158 ♂ • 6 ♀ Sudden onset: N = 137, aged 19-86 • 131 ♂ • 6 ♀	Occupation and employment: retired, sedentary, clerical, manual and heavy labour.	In the sudden onset group, predisposing factors predisposing to inguinal herniation was examined.	Type of event predisposing herniation (n = 137): • Lifting: n = 93 (67.9%) • Coughing: n = 20 (14.6%) • Exercise: n = 14 (10.2%) • Gardening: n = 10 (7.3%)
Vad, et al. 2012 Retrospective	Data from administrative and medical registers in Denmark, that is, the Danish Civil Registration System (CRS), the Employment Classification Module (ECM), the Danish National Patient Register (NPR),	One ton-year was defined as lifting one ton per day for 1 year.	Zero ton-years was used as a reference compared to 0-1 to 4-17.5 ton-years. OR was adjusted for	*Lateral inguinal hernia* Ton-years (n cases): • 0: 5083 OR (95% CI): 1.00 • 0-1: 3157

cohort study (14/16)	and the Danish Hernia Database (DHDB). N= 1 545 987 men, age 18-65 • 22926 lateral hernias • 15877 medial hernias • 1592 pantaloon or unspecified hernias		age at 1 January each year, socioeconomic status (1-5, categorised with group 1 as reference), region of residence (eight regions based on zip codes), calendar year, and number of follow-up intervals (whole years)	OR (95% CI): 1.05 (1.00-1.10) • 1-2: 3745 OR (95% CI): 1.23 (1.17-1.28) • 2-3: 3008 OR (95% CI): 1.27 (1.21-1.34) • 3-4: 2102 OR (95% CI): 1.35 (1.28-1.43) • 4-17.5: 5719 OR (95% CI): 1.32 (1.27-1.38) *Medial inguinal hernia* Ton-years (n cases): • 0: 4415 OR (95% CI): 1.00 • 0-1: 2286 OR (95% CI): 0.95 (0.90-1.00) • 1-2: 2623 OR (95% CI): 1.06 (1.00-1.11) • 2-3: 1895 OR (95% CI): 1.00 (0.94-1.05) • 3-4: 1193 OR (95% CI): 0.98 (0.91-1.05)

				• 4-17.5: 3410 OR (95% CI): 0.99 (0.94-1.05)
Vad, et al. 2012 Retrospective cohort study (14/16)	Data from administrative and medical registers in Denmark, that is, the Danish Civil Registration System (CRS), the Employment Classification Module (ECM), the Danish National Patient Register (NPR), and the Danish Hernia Database (DHDB). N= 1 545 987 men, Age 18-65 • 22926 lateral hernias • 15877 medial hernias • 1592 pantaloon or unspecified hernias	One frequent-heavy-lifting-year as lifting objects weighing 20 kg or more at least 10 times a day for 1 year.	Zero frequent-heavy-lifting-years was used as a reference compared to frequent-heavy-lifting-years of 0-10 to 40-48. OR was adjusted for age at 1 January each year, socioeconomic status (1-5, categorised with group 1 as reference), region of residence (eight regions based on zip codes), calendar year, and number of follow-up intervals (whole years)	*Lateral inguinal hernia* Frequent-heavy-lifting-years (n cases): • 0: 5178 OR (95% CI): 1.00 • 0-10: 3244, 1.06 (1.01-1.11) OR (95% CI): 1.06 (1.01-1.11) • 10-20: 3312 OR (95% CI): 1.20 (1.14-1.25) • 20-30: 2506 OR (95% CI): 1.26 (1.20-1.33) • 30-40: 2807 OR (95% CI): 1.34 (1.28-1.41) • 40-48: 5767 OR (95% CI): 1.33 (1.28-1.39) *Medial inguinal hernia* Frequent-heavy-lifting-years (n, OR): • 0, 4515

				OR (95% CI): 1.00 • 0-10, 2285 OR (95% CI): 0.94 (0.90-1.00) • 10-20, 2294 OR (95% CI): 1.03 (0.97-1.08) • 20-30, 1568 OR (95% CI): 0.95 (0.89-1.01) • 30-40, 1706 OR (95% CI): 1.02 (0.96-1.08) • 40+, 3460 OR (95% CI): 1.00 (0.95-1.06)
Vad, *et al.* 2017 Follow-up study (14/16)	Data from the Musculoskeletal Research Database (MRD) at the Danish Ramazzini Centre was used. The MRD originally contained questionnaire data from 39590 persons, who had participated in at least one of nine studies of Danish working populations, which were conducted from 1993 to 2004.	The total load lifted per day was categorised as 0 (reference), > 0 –<1000 and 1000 –≤ 4900kg/day.	The total load lifted per day of 0 was used as a reference compared to >0-<1000 and 1000-≤4900 kg/day. HR_{adj} was adjusted for age at the start of follow-up	*Lateral inguinal hernia* Total load lifted per day (kg/day): 0 (n person years, n cases) (reference): • 68156 • 117 HR_{adj}: 1.00 $HR_{fully\ adj}$: 1.00 Total load lifted per day (kg/day): 0-1000: • 74266

	Since then, questionnaire data from 4325 participants in a general practice study from 2008 have been added, including 1858 men who reported that they were occupationally active. N = 17967 men aged 18-65 y/o (birth years 1932-1990, both years included). • 382 lateral hernia repairs • 314 medial hernia repairs		$HR_{fully\ adj}$ was adjusted for age at the start of follow-up, body mass index, leisure-time physical activity, smoking status and year of data collection in the original study.	• 141 HR_{adj} (95% CI): 1.14 (0.89-1.46) $HR_{fully\ adj}$ (95% CI): 1.14 (0.88-1.61) Total load lifted per day (kg/day): 1000-≤4900: • 58888 • 124 HR_{adj} (95% CI): 1.32 (1.02-1.72) $HR_{fully\ adj}$ (95% CI): 1.22 (0.89-1.66) *Medial inguinal hernia* Total load lifted per day (kg/day): 0 (n person years, n cases) (reference): • 68156 • 109 HR_{adj}: 1.00 $HR_{fully\ adj}$: 1.00 Total load lifted per day (kg/day): 0-1000:

				• 74266 • 114 HR_{adj} (95% CI): 0.99 (0.75-1.28) $HR_{fully\ adj}$ (95% CI): 1.00 (0.76-1.32) Total load lifted per day (kg/day): 1000-≤4900: • 58888 • 91 HR_{adj} (95% CI): 1.03 (0.77-1.37) $HR_{fully\ adj}$ (95% CI): 0.94 (0.66-1.32)
Vad, *et al.* 2017 Follow-up study (14/16)	Data from the Musculoskeletal Research Database (MRD) at the Danish Ramazzini Centre was used. The MRD originally contained questionnaire data from 39590 persons, who had participated in at least one of nine studies of Danish working populations, which were	The daily frequency of lifting loads weighing ≥20kg was categorised as <2 (reference), 2–<11 and 11–≤89lifts/day.	The daily frequency of lifting loads weighing ≥20kg <2 lifts/day was used as a reference compared to 2-<11 and 11-<89 lifts/day. HR_{adj} was adjusted for age at the start of follow-up	*Lateral inguinal hernia* Frequency of lifting loads weighing 20+ kg (lifts/day): 0-2 (n person years, n cases) (reference): • 73902 • 125 HR_{adj}: 1.00 $HR_{fully\ adj}$: 1.00

	conducted from 1993 to 2004. Since then, questionnaire data from 4325 participants in a general practice study from 2008 have been added, including 1858 men who reported that they were occupationally active. N = 17967 men age 18-65 (birth years 1932-1990, both years included). • 382 lateral hernia repairs • 314 medial hernia repairs		$HR_{fully\ adj}$ was adjusted for age at the start of follow-up, body mass index, leisure-time physical activity, smoking status and year of data collection in the original study.	Frequency of lifting loads weighing 20+ kg (lifts/day): 2-11 • 63327 • 127 HR_{adj}: 1.20 (0.94-1.54) $HR_{fully\ adj}$: 1.19 (0.91-1.54) Frequency of lifting loads weighing 20+ kg (lifts/day): 11-89 • 64082 • 130 HR_{adj}: 1.31 (1.01-1.67) $HR_{fully\ adj}$: 1.21 (0.91-1.62) *Medial inguinal hernia* Frequency of lifting loads weighing 20+ kg (lifts/day): 0-2 (n person years, n cases) (reference): • 73902 • 114 HR_{adj}: 1.00

				$HR_{fully\ adj}$: 1.00 Frequency of lifting loads weighing 20+ kg (lifts/day): 2-11 • 63327 • 105 HR_{adj} (95% CI): 1.09 (0.84-1.43) $HR_{fully\ adj}$ (95% CI): 1.04 (0.82-1.32) Frequency of lifting loads weighing 20+ kg (lifts/day): 11-89 • 64082 • 95 HR_{adj} (95% CI): 1.03 (0.78-1.36) $HR_{fully\ adj}$ (95% CI): 0.86 (0.64-1.14
Standing/walking				
Vad, et al. 2012	Data from administrative and medical registers in Denmark, that is, the Danish Civil Registration System (CRS), the Employment Classification	One standing-year was defined as standing / walking 6h per day for 1year—for example, standing/walking 3 h per day for 1 year was given a value of 0.5	Zero standing-years was used as a reference compared to standing years from 0-2 till 5-6.	*Lateral inguinal hernia* Standing-year (n cases): • 0: 5060 OR (95% CI): 1.00

Prospective cohort study (14/16)	Module (ECM), the Danish National Patient Register (NPR), and the Danish Hernia Database (DHDB). N= 1 545 987 men, age 18-65 • 22926 lateral hernias • 15877 medial hernias • 1592 pantaloon or unspecified hernias	standing-years.	OR was adjusted for age at 1 January each year, socioeconomic status (1-5, categorised with group 1 as reference), region of residence (eight regions based on zip codes), calendar year, and number of follow-up intervals (whole years)	• 0-2: 4425 OR (95% CI): 1.07, (1.02-1.11) • 2-3: 2681 OR (95% CI): 1.17, (1.11-1.23) • 3-4: 4472 OR (95% CI): 1.31, (1.25-1.37) • 4-5: 4564 OR (95% CI): 1.36, (1.30-1.42) • 5-6.1: 1675 OR (95% CI): 1.43, (1.34-1.51) *Medial inguinal hernia* Standing-year (n, OR): • 0: 4403 OR (95% CI): 1.00 • 0-2: 3005 OR (95% CI): 0.93, (0.88-0.97) • 2-3: 1781 OR (95% CI): 0.96, (0.90-1.02) • 3-4: 2953 OR (95% CI): 1.06, (1.01-1.12) • 4-5: 2690

				OR (95% CI): 1.00, (0.95-1.06) • 5-6.1: 1053 OR (95% CI): 1.14, (1.06-1.23)
Vad, *et al.* 2017 Follow-up study (14/16)	Data from the Musculoskeletal Research Database (MRD) at the Danish Ramazzini Centre was sed. The MRD originally contained questionnaire data from 39590 persons, who had participated in at least one of nine studies of Danish working populations, which were conducted from 1993 to 2004. Since then, questionnaire data from 4325 participants in a general practice study from 2008 have been added, including 1858 men who reported that they were occupationally active. N = 17967 men age 18-65 (birth years 1932-1990, both years	Standing/walking was categorised as < 4 (reference), 4 –<6 and 6 –≤ 7.3hours/day.	Standing/walking for <4 hours/day was used as a reference compared to 4-<6 hours a day and 6-<7.3 hours/day HR_{adj} was adjusted for age at the start of follow-up $HR_{fully\ adj}$ was adjusted for age at the start of follow-up, body mass index, leisure-time physical activity, smoking status and year of data collection in the original study.	*Lateral inguinal hernia* Standing/walking (hours/day): 0-4 (n person years, n cases) (reference): • 91010 • 149 HR_{adj}: 1.00 $HR_{fully\ adj}$: 1.00 Standing/walking (hours/day): 4-6 • 21279 • 32 HR_{adj} (95% CI): 0.88 (0.60-1.30) $HR_{fully\ adj}$ (95% CI): 0.89 (0.61-1.31) Standing/walking (hours/day): 6-7.3 • 89022 • 201 HR_{adj} (95% CI): 1.42 (1.15-1.76) $HR_{fully\ adj}$ (95% CI): 1.45 (1.12-1.88)

	included). • 382 lateral hernia repairs • 314 medial hernia repairs			*Medial inguinal hernia* Standing/walking (hours/day): 0-4 (n person years, n cases) (reference): • 91010 • 130 HR_{adj}: 1.00 $HR_{fully\ adj}$: 1.00 Standing/walking (hours/day): 4-6 • 21279 • 33 HR_{adj} (95% CI): 1.04 (0.71-1.53) $HR_{fully\ adj}$ (95% CI): 1.06 (0.72-1.56) Standing/walking (hours/day): 6-7.3 • 89022 • 151 HR_{adj} (95% CI): 1.20 (0.95-1.53) $HR_{fully\ adj}$ (95% CI): 1.25 (0.93-1.66)

Bijlage III GRADE criteria en beoordeling

<table>
<tr><td colspan="5">Initial quality*</td></tr>
<tr><td></td><td></td><td></td><td>Aandachtspunten</td><td>Overwegen om te downgraden als</td></tr>
<tr><td rowspan="8">Down grading</td><td rowspan="7">No (0)
Serious (-1)
Very serious (-2)</td><td rowspan="2">Risk of Bias</td><td>% prospectieve studies</td><td><50%</td></tr>
<tr><td>% studies met hoog risico op bias</td><td>≥50%</td></tr>
<tr><td rowspan="2">Inconsistency</td><td>hoge heterogeniteit</td><td>I2≥70%</td></tr>
<tr><td>betrouwbaarheidsintervallen</td><td>geen of minimale overlap</td></tr>
<tr><td rowspan="2">Indirectness</td><td>diagnose door arts/paramedicus</td><td>nee</td></tr>
<tr><td>werkenden zijn onderzoekspopupatie</td><td>nee</td></tr>
<tr><td rowspan="2">Imprecision</td><td>aantal ziektegevallen</td><td>n<95</td></tr>
<tr><td>zekerheid over effectgrootte</td><td>geen zekerheid als de effectgrootte 1 in het betrouwbaarheidsinterval zit, tenzij het betrouwbaarheidsinterval tussen 0,8 en 1,2 ligt</td></tr>
<tr><td>Undetected
Strongly suspected (-1)</td><td>Publication Bias</td><td>waarschijnlijk</td><td>op basis van het oordeel van de auteurs</td></tr>
<tr><td colspan="5">Let op: als er is gedowngrade, dan mag je niet meer upgraden</td></tr>
<tr><td rowspan="3">Up grading</td><td rowspan="3">+1 or +2</td><td>Large effect</td><td>ondergrens 95% betrouwbaarheidsinterval</td><td>≥2</td></tr>
<tr><td>Dose-response</td><td>aanwezig</td><td>op basis van de analyse van de auteurs</td></tr>
<tr><td>No plausible confounding~</td><td>afwezig</td><td>op basis van de analyse van de auteurs</td></tr>
<tr><td colspan="5">Certainty</td></tr>
</table>

*De start van de kwaliteit begint met hoog en kan dalen van redelijk tot laag en zeer laag.

Initial quality	Downgrading					Gedowngrade	Upgrading			Certainty
High / Low	No (0) serious (-1) very serious (-2)				Undetected strongly suspected (-1)	Ja>geen upgrade nee>upgrading ?	+1 or +2			High Moderate Low Very low
	Risk of Bias	**Inconsistency**	**Indirectness**	**Imprecision**	**Publication Bias**		**Large effect**	**Dose response**	**plausible confounding**	

Studie design	#studies	% prosp studies	%studies hoog	hetero-geniteit	diagnosis door arts/paramedicus	werkenden	aantal cases	zekerheid effect	waarschijnlijk	Gedowngrade ja/nee ?	ondergrens 95% BI	aanwezig	afwezig	
		<50%	≥50%	I2≥70%	nee	nee	<95	niet sign 1 in 95%BI, tenzij BI 0,8-1,2	ja	**Geen downgrade**	2	nee	nee	
Physical work load	**3**	33%	<50%	49%	yes	yes	621	2.30 (1.56-3.40)	No	**Yes**	Not applicable	Not applicable	Not applicable	Moderate

Standing Years >5-6.1 or	**1**	100%	<50%	Not applicable	yes	yes	22.926 lateral	1.43 (1.34-1.51)	No	**No**	1.34	Yes, p for trend $<10^{-3}$	No	High
Standing/Walking 6 hours per day	**1**	100%	<50%	Not applicable	yes	yes	382 lateral	1.45 (1.12-1.88)	No	**No**	1.12	No	Yes	High
Lifting (>4000 kg/day)	**1**	100%	<50%	Not applicable	yes	yes	22.926 lateral	1.32 (1.27-1.38)	No	**No**	1.27	Yes, p for trend $<10^{-3}$	No	High
Lifting (>1000-≤4900 kg/day)	**1**	100%	<50%	Not applicable	yes	yes	382 lateral	1.22 (0.89.-1.66)	**No**	Not applicable	Not applicable	Not applicable	Not applicable	Moderate