

Data of individual publications reporting on agents, professions or worksites causing allergic asthma

Agents	Strength of evidence per agent (three star system of RCGP)	Total no. of allergic asthma cases per agent, n	Reference	Level of evidence per study (revised SIGN grading system); study type.	Occupationally exposed subjects studied, n	Allergic asthma cases due to mentioned agent, n, prevalence (%). Cases with probable allergic asthma but specific sensitization not confirmed in parentheses [] or not indicated.	EVIDENCE (pathological results)																				Remarks			
							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE		
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	n/n NSBHR	n/n PFT	Reaction			n/n SPT	n/n IgE				
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%				n/n SIC	i	l				d	n	
												%	%	%	%	%	%	%	%	%	%	%								
High-molecular-weight compounds																														
ANIMALS (ANIMALIA)																														
JOINT-LEGS (ARTHROPODA)																														
ARACHNIDS (ARACHNIDA)																														
Mites (Acarina)																														
Predatory mites (Phytoseiidae)																														
	***	35																												
Thrips mite (<i>Amblyseius cucumeris</i>)			Groenewoud, Veld et al., 2002	2-; cross-sectional	472	28 (5.9)	28/109*	25.7	78/109*	71.6	53/109	48.6	nd	14/109	12.8	83/109*	76.1	nd	nd	nd	nd	109/472	23.1	63/109	57.8	Greenhouse employees in bell pepper horticulture, co-exposed and co-sensitized to both sweet bell pepper pollen and/or plant (80/109 SPT+) and <i>Tyrophagus putrescentiae</i> (62/472 SPT+). *WRS listed for sensitized subjects only; nasal Ch in 23 sensitized employees; those with WR rhinitis had sign. More frequently responses than employees without WR rhinitis, individual results not listed				
Predatory mites (<i>Phytoseiulus persimilis</i> and <i>Hypoaspis miles</i>)			Kronqvist, Johansson et al., 2005	2-; cross-sectional	96	6 (6.3)	13/96	13.5	32/96	33.3	32/96	33.3	nd	nd	36/96	37.5	13/91*	14.3	nd	nd	nd	nd	nd	17/96	17.7	Greenhouse workers. *FEV1 <80% pred., none of the asthmatics was LFT+; 23/96 IgE+ to <i>T. urticae</i> , 14/96 IgE+ to <i>D. pteronyssinus</i> and/or <i>D. farinae</i> ; 6/13 asthmatics IgE+ to at least one predatory mite				
Predatory mites (<i>Phytoseiulus persimilis</i> and <i>Hypoaspis miles</i>)			Johansson, Kolmodin-Hedman et al., 2003	3+; cross-sectional	31	.*	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	16/31**	51.6	Greenhouse workers employed at 9 randomly selected greenhouses. *Only IgE sensitization is described. 16/31 SPT+ with <i>Hypoaspis miles</i> , 10/31 SPT+ with <i>P. persimilis</i> and 8/31 SPT+ with <i>T. urticae</i> ; **SPT+ to at least one of the 3 mites tested					
Thrips mite (<i>Amblyseius cucumeris</i> and <i>Amblyseius cucumeris</i>)			Skougaard, Thisling et al., 2010	3; case report	1	1	1/1		1/1		1/1		1/1	nd	nd	1/1					1/1	1	1/1*	nd	Gardener; *SPT+ for <i>A.cucumeris</i> but not for <i>A. californicus</i>					
Spider mites (Tetranychidae)																														
	***	174																												
Two-spotted spider mite or red spider mite (<i>Tetranychus urticae</i>)			Astarita, Gargano et al., 2001	2-; cross-sectional	960	28 (2.9)	23/960	2.4	32/960	3.1	nd	nd	nd	11/960	1.1	46/960	4.8	nd	nd	31/47*	66	nd	nd	58/960	6.0	nd	Greenhouse and open-field farmers. *Serial PEFR in symptomatics and SPT+; 28/31 PFT+ were sensitized; 9 SIC+ and SPT+ with tomato, 3 SIC+ and SPT+ with celery, 4 SIC+ and SPT+ with tobacco; sign. more symptomatics and SPT+ to <i>T.urticae</i> among the greenhouse workers as farmers working in open fields			
Two-spotted spider mite (<i>Tetranychus urticae</i>)			Navarro, Delgado et al., 2000	2-; cross-sectional	246	[17]	17/246	6.9	43/246	17.5	43/246	17.5	nd	12/246	4.9	69/246	28.0	nd	nd	nd	nd	nd	61/241	25.3	29/110	26.4	Greenhouse workers. Sign. correlation between time of exposure and frequency of sensitized symptomatics (n=46); specific sensitization sign. increased among exposed. *Sensitized asthmatics not listed, 26% of SPT+ workers were asymptomatic.			
Two-spotted spider mite (<i>Tetranychus urticae</i>)			Jeebhay, Baatjies et al., 2007	2-; cross-sectional	207	11 (5.3)	54/207*	26.1	49/207	23.7	49/207	23.7	nd	30/207	14.5	nd	nd	nd	nd	nd	nd	nd	42/190	22.1	32/201	15.9	Table grape farm workers. *WR wheeze; 19/207 had physician diagnosed asthma; 11/54 with WR wheeze were SPT+; 10/54 IgE+; 40/201 IgE+ to <i>D. pteronyssinus</i> , 26/201 IgE+ to <i>L. destructor</i> ;			
Spider mites			Kim, Lee et al., 1999	3+; survey	725	49 (6.8)	119/725	16.4	129/725	17.8	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	118/465*	25.4	nd	nd	Apple-cultivating farmers. *SPT+ with at least one spider mite; sign. increased prevalence of asthma among SPT+ subjects; 37/118 SPT+ were asthmatics; 49/119 asthmatics were SPT+ to at least on spider mite				
<i>Panonychus ulmi</i>						48																	108/465	23.2						
<i>Tetranychus urticae</i>						32																	77/465	16.6						
<i>Tyrophagus putrescentiae</i>						25																	98/465	21.1						
Citrus red mite (<i>Panonychus citri</i>)			Kim, Son et al., 1999	3+; cross-sectional	181	11 (6.1)	55/181*	30.3	83/181	45.9	nd	nd	nd	nd	nd	nd	22/55**	12.2	nd	nd	nd	nd	30/181	16.6	45/123	36.6	Citrus farmers. *Not clear whether WR; **NSBHR done in asthmatic subjects only, 12/22 NSBHR+ were IgE+ and SPT+; 11 NSBHR+ subjects had WR asthma and SPT+			
Citrus red mite (<i>Panonychus citri</i>)			Park, Kim et al., 2000	3+; cross-sectional	136	11 (8.1)	45/136	33.1	64/136	47.1	nd	nd	nd	nd	nd	nd	nd	+	+	nd	nd	+	+	54/136	39.7	Citrus farmers. *NSBHR done in asthmatics only, 11 asthmatics were both NSBHR+ and IgE+; **all 11 CRM sensitive asthma cases and 25 CRM sensitive rhinitis cases were SPT+				

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							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE								
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction			n/n SPT	%		n/n IgE	%				
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%	i						n	l	n	d
Spider mites (<i>Tetranychus urticae</i> , <i>Panonychus citri</i>)			Burches, Pelaez et al., 1996	3+; case series	150	0	0/150		3/150	2.0	3/150	2.0	nd		2/150	1.3	5/150	3.3	nd		nd		nd		nd		nd		54/150	36	54/54		150 citrus farmers referred to an allergy unit. *All SPT+ subjects were IgE+; 48/54 sensitized were Conj, Ch+; all sensitized subjects were SPT+ to <i>D. pteronyssinus</i> ; sign. cross-reactivity between <i>Tetranychidae</i> and <i>D. pteronyssinus</i>			
<i>Tetranychus urticae</i>			Astarita, Franzese et al., 1994	3+; case series	46	19 (41.3)	19/46	41.3	46/46	100	nd		19/49	41.3	17/46	37	46/46	100	nd		nd		19/46*	41.3	nd				36/46	78.3	36/46	78.3	Farm workers: 30 field-workers, 16 greenhouse-workers. *PEFR+ were all sensitized			
Red spider mite (<i>Tetranychus urticae</i>)			Delgado, Orta et al., 1997	3+; case series	24	14 (58.3)	15/24	62.5	14/24	58.3	nd		nd		5/24	20.8	24/24	100	nd		12/13*	92.3	nd		12/14*	85.7	6	6	16/24	66.7	16/24	66.7	Carnation greenhouse workers, all SPT- with carnation; *BHR and SIC done in 14/16 of sensitized asthmatics			
Citrus red mite (<i>Panonychus citri</i>)			Kim, Son et al., 1999	3+; case series	16	16 (100)	16/16		15/16		nd		nd		nd		16/16		9/16		7/7*		nd		1/1		1		16/16		16/16		Farmers cultivating citrus fruit. *BHR done in all subjects with normal LFT			
Citrus red mite (<i>Panonychus citri</i>)			Ashida, Ide et al., 1995 ABSTRACT	3+; case series	12	-	-		-		-		-		-		-		-		-		-		-			10/12		7/12		Symptomatic fruitgrowers. *Immediate allergic symptoms not given in more detail.				
Red spider mite (<i>Panonychus ulmi</i>)			Kroidl, Maasch et al., 1992	3+; case series	6	6 (100)	6/6	100	6/6	100	6/6	100	nd		6/6	100	6/6	100	nd		nd		nd		4/4	100	4		6/6	100	3/6	50	Fruit tree workers			
MacDaniel spider mite (<i>Tetranychus macdanieli</i>)			Carbannelle, Lavaud et al., 1986	3+; case series	7	4 (57.1)	4/7	57.1	4/7	57.1	nd		nd		nd		7/7	100	nd		nd		nd		nd			7/7	100	nd	nd	Vine growers				
European red mite (<i>Panonychus ulmi</i>)			Michel, Guin et al., 1977	3+; case series	5	2 (40)	2/5	40	4/5	80	4/5	80	2/5	40	3/5	60	5/5	100	nd		nd		nd		nd			5/5*	100	nd	nd	Apple growers. *IC				
Red spider mite (<i>Tetranychus urticae</i>)			Delgado, Gómez et al., 1994	3; case report	1	1	1/1		1/1		1/1		1/1		nd		1/1		0/1		0/1		1/1		1/1		1	1/1		1/1		Carnation nursery worker				
<i>Tetranychus urticae</i>			Cisteró-Bahima, Enrique et al., 2000	3; case report	1	1	1/1		nd		nd		1/1		nd		1/1		0/1		1/1		1/1		nd			1/1		1/1		Flower cultivator with simultaneous OA to carnation				
<i>Panonychus ulmi</i>			Erlam, Johnson et al., 1996 ABSTRACT	3; case report	1	1	1/1		-		-		-		-		-		-		-		-		-			1/1		1/1		Tomato growing greenhouse worker				
Storage mites (Acaridae, Glycyphagidae)	**	130																																		
Storage mites			Kronqvist, Johansson et al., 1999	2+; 12 cohort study	1015	-		9.8*		33.1*		33.1*		nd			41.7*		nd		nd		nd		nd						8.1*		*Estimated prevalence for the whole population of dairy farmers (n=1015) based on a random sample of 461 farmers tested; estimated prevalence of asthma and asthma in combination with RC for all dairy farmers on Gotland had increased sign. during the previous 12 years (5.3% vs 9.8%) and (3.7% vs 7.0%); 25% of asthmatics and 25% of subjects with asthma and RC were IgE+			
<i>Acarus siro</i>																															6.1*					
<i>Glycyphagus domesticus</i>																															3.8*					
<i>Lepidoglyphus destructor</i>																																6.6*				
<i>Tyrophagus putrescentia</i>																																6.2*				
Storage mites			Hage-Hamsten van, Johansson et al., 1985	2+; cross-sectional	440	26 (5.9)	128/440	29.1	288/440	65.5	288/440	65.5	128/440	29.1	nd		310/440	70.5	nd		nd		nd		nd						53/440	12.0	A random sample of 440 farmers on Gotland of a total of 2578. *Asthma and/or cough; 26/128 asthmatics were IgE+ to <i>L. destructor</i> (measured by MIAB Allergo-Discs®); calculated prevalence of storage mite allergy in the whole population of Gotland was 6.2% and allergy to storage mites among symptomatic farmers was 15.4%			
<i>Ararus siro</i>																																				
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Storage mite <i>L. destructor</i>			Hage-Hamsten van, Johansson et al., 1987	2+; cross-sectional	440	[30]	128/440	29.1	288/440	65.5	288/440	65.5	118/440	26.8	nd		310/440	70.5	nd		nd		nd		nd						30/440	6.8	A random sample of farmers on Gotland of a total of 2578, same as the study above. IgE measured with Phramacia Diagnostics Phadebas® RAST			
Storage mites			Cuthbert, Jeffrey et al., 1984	2+; cross-sectional	290	27 (9.3)	36/290	12.4	72/290	24.8	53/290	18.3	nd		nd		87/290	30	nd		nd		nd		nd					108/290	37.2	38/219	17.4	Farm workers from 102 randomly selected farms: 162 dairy farmers and 128 stock-raising farmers. 27/36 asthmatics were SPT+		
<i>Acarus farris</i>																																				
<i>Lepidoglyphus destructor</i>																																				
<i>Tyrophagus tonior</i>																																				
Storage mites			Blaieva, Topping et al., 1989	2+; cross-sectional	133	21 (15.8)	43/133	32.3	nd		nd		nd		nd		43/133	32.3	5/116	4.3	24/116	20.7	nd		1/1*		1			32/130**	24.6	30/128**	23.4	Grain-store workers. *SIC with storage mite mix; **SPT+ and IgE+ with at least one storage mite; 21 asthmatics SPT+ and 15 asthmatics IgE+; sign. association between WRS and sensitization; 13/130 SPT+ with at least one grain		
<i>Acarus siro</i>																																				
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							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%						i
Cricket (<i>Acheta domestica</i> , <i>Gryllus campestris</i> , <i>Gryllus bimaculatus</i>)			Linares, Hernandez et al., 2008	3; case report	1	1	1/1		1/1		nd	nd	nd	1/1		nd	1/1		1/1		1/1		1	1/1		1/1*	*Spec. IgE+ for <i>G. campestris</i> , <i>G. bimaculatus</i> , <i>A. domestica</i> and crushed, fire bug, grasshopper, prawn, and squid but higher levels of specific IgE for the 3 species of crickets					
Cricket (<i>Acheta campestris</i>)			Bartra, Camés et al., 2008	3; case report	1	1	1/1		1/1		1/1	nd	1/1		0/1	nd		1/1		1/1		1		1/1		nd	Assistant in a reptile shop monosensitized to cricket					
Dermestidae spp. beetle (order Coleoptera)	-	2	Brito, Mur et al., 2002	3; case report	1	1	1/1		1/1		1/1		1/1		nd	0/1		1/1*		1/1		1		1/1		1/1	Wool worker. *PEFR twice a day for 3 months; conj. Ch+					
Dermestid beetle larvae (order Coleoptera)			Sheldon and Johnston, 1941	3; case report	1	1	1/1*		1/1		nd	nd	1/1		nd	nd		nd		++				1/1		nd	Museum curator. *Work-exacerbated; **clinical asthmatic symptoms after SIC, LFT not tested; passive transfer test+					
Flour moth (<i>Ephesia</i> and <i>Eurygaster</i>)	[*]	8	Armentia, Lombardero et al., 2004	3+; cross sectional	15	7 (46.6)	15/15	100	7/15	46.6	nd	nd	nd	nd	nd	nd	nd	nd	7/8*	87.5				15/15	100	2/15**	13.3	15 asthmatic bakers or farmers exposed to cereal dust * 8 refused SIC ** 2/15 positive with pure wheat				
Flour moth (<i>Ephesia kuehniella</i>)			Mäkinen-Kiljunen, Mussalo-Rauhamaa et al., 2001	3; case report	1	1	1/1		1/1		1/1	1/1	nd	1/1	0/1	1/1		1/1		1/1				1/1		1/1	Baker. Nasal Ch+					
Fruit fly (<i>Drosophila melanogaster</i>)	-	3	Spiekma, Vooren et al., 1986	3+; cross-sectional	22	3 (13.6)	4/22	18.2	7/22	31.8	3/22	13.6	nd	nd	7/22	31.8	nd	nd	nd	nd	3/14*	21.4	3	9/22**	40.9	10/22	45.5	Workers in a scientific laboratory. *Nasobronchial Ch, 9/14 nasal reaction; **IC;				
Grain weevil (<i>Sitophilus granarius</i>), order Coleoptera	-	-*	Rosenau, Wittemann et al., 1993		53	-*						nd	nd	53/53		nd	nd	nd	nd	nd				nd		8/53	Bakers with occupational airways diseases: *rhinitis, conj., and/or asthma, individual figures not listed					
Grasshopper (<i>Melanoplus sanguinipes</i>)	-	4	Soparkar, Patel et al., 1993	3+; survey with index case	17	4 (23.5)	4/17	23.5	1/1*		1/1*		nd	9/17	52.9	10/17	58.8	0/1*	1/1*		1/1*	1		7/16	43.8	nd	Research laboratory workers. *Tests done only in case report; sensitization in exposed sign. higher; sign. correlation between WR asthma and SPT+: all asthmatics SPT+; clinical tests done with grasshopper droppings					
Ground bugs (family Lygaeidae: <i>Metopoplax ditomoides</i> et <i>Microplax albofasciata</i>)	-	1	Lázaro, Muela et al., 1997	3; case report	1	1	1/1		1/1		1/1	nd	1/1	1/1	1/1	1/1	1/1	1/1*		1/1*				1/1		1/1	Employee bottling mineral water. *Serial PEFR at work and off-work for 6 weeks; conj. Ch+					
Gypsy moth caterpillar (<i>Lymantria dispar</i>)	-	2	Etkind, Thomas et al., 1982	3+; survey	17	2 (11.8)	2/17	11.8	nd		4/17	23.5	nd	10/17	58.8	10/17	58.8	nd	nd	nd	nd			15/17*	88.2	nd	Laboratory workers. *Scratch test; both asthmatics were scratch test+					
Herring worm (<i>Anisakis simplex</i>)	-	3	Armentia, Lombardero et al., 1998	3; case reports	2	2	2/2		1/2		nd	nd	nd	2/2		nd	1/1	nd	nd	2/2		1	1	2/2	2/2	2/2	Chicken breeder and fish monger. 1/1 SPT- with fish					
			Scala, Giani et al., 2001	3; case report	1	1	1/1		0/1		0/1	1/1	1/1	1/1	1/1	1/1	1/1	nd	nd	nd				1/1		1/1	Employee in a frozen fish factory. SPT- with all fish tested					
Honeybee (<i>Apis mellifera</i>)	-	1	Ostrom, Swanson et al., 1986	3; case report	1	1	1/1		nd		nd	1/1	nd	1/1	0/1	nd	nd	nd	1/1		1/1	1		1/1		1/1	Honey-processing plant employee. IgE- with pollen					
Lentil pest (<i>Bruchus lentis</i>)	-	1	Armentia, Lombardero et al., 2003	3; case report	1	1	1/1		1/1		1/1	nd	nd	1/1	nd	nd	nd	nd	1/1*		1/1*			1/1		1/1**	Agronomist. *SIC reaction type not listed; **IgE+ with infested lentil; SPT-, IgE- and SIC- with lentil					
Lesser mealworm (<i>Alphitobius diaperinus</i> (Panzer)), order Coleoptera	-	2	Schroekenstein, Meier-Davis et al., 1988	3; case reports	3	2 (66.6)	2/3	66.6	2/3	66.6	1/3	33.3	nd	2/3	66.6	3/3	100	nd	nd	nd				3/3	100	3/3	100	Research entomologists				
Live fish bait (LFB)	*	16	Siracusa, Marucci et al., 2003	2; cross-sectional	76	3 (3.9)	3/76	3.9	5/76	6.6	5/76	6.6	nd	1/76	1.3	7/76	9.2	nd	nd	nd				24/76	31.6	12/64	18.8	50 workers in 8 LFB farms, 8 retailers, 18 laboratory workers. Sensitization to LFB and WRS were strongly associated; IgE and SPT results for symptomatics in brackets				
Bluebottle (<i>Calliphora vomitoria</i>)																																
Beemoth (<i>Galleria mellonella</i>)																																
Gusano rojo (<i>Cilecomadia moorei</i>)																																
Mealworm (<i>Tenebrio molitor</i>)																																
Live fish bait (LFB)			Siracusa, Bettini et al., 1994	3+; case series	14	12 (85.7)	13/14	92.8	14/14	100	nd	nd	nd	3/14	21.4	14/14	100	nd	nd	7/13	53.8	5/7*	71.4	nd	13/14	92.8	13/14	92.8	3 workers of a fish bait farm and 11 anglers. *PEFR at exposure day and non-exposure day (2 immediate, 3 late); 12/13 asthmatics sensitized; no cross-reactivity of larval extracts detected			
Beemoth (<i>Galleria mellonella</i>)																																
Greenbottle (<i>Lucilia caesar</i>)																																
Mealworm (<i>Tenebrio molitor</i>)																																

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							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction			n/n SPT	%	n/n IgE	%				
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%						i	n	l	n
Live fish bait (LFB) Beemoth (<i>Galleria mellonella</i>)			Stevenson, Mathews et al., 1967	3; case report	1	1	1/1		1/1		nd		nd		nd		nd		nd		nd		1/1		nd		1/1		nd		1/1		nd		Worker of a commercial fish bait establishment
Locust (<i>Schistocerca gregaria</i> and <i>Locusta migratoria</i>), cicada	*[*]	19	Burge, Edge et al., 1980	2-; cross-sectional	90	11 (12.2)	13/90	14.4	20/90	22.2	nd		nd		17/90	18.9	nd		x*		nd		nd									29/87	33.3	x**	90 exposed and 28 non-exposed (admin. staff) in a research centre; 7/28 admin. staff SPT+; *asthmatics had a reduced mean FEV1; **IgE+ correlated sign. with degree of exposure and WR asthma; 11/12 asthmatics SPT+; co-exposure and co-sensitization (11/87 SPT+) to moth (<i>Chilo partellus</i>)
			Tee, Gordon et al., 1988	3+; Cross-sectional	15	5 (33.3)	5/15	33.3	9/15	60	nd		nd		8/15	53.3	9/15	60	nd		nd		nd								10/15*	66.7	11/15**	73.3	15 currently exposed in a research center. *SPT+ with at least one antigen; **IgE+ with a mixture of <i>S. g.</i> and <i>L. m.</i> ; all symptomatics were sensitized; sign. association between SPT and exposure
					20		nd		nd		nd		nd		nd		nd		nd		nd		nd						2/20*	10	7/20**	35	20 employees in a research center with past exposure. *SPT+ with at least one antigen; **IgE+ with a mixture of <i>S. g.</i> and <i>L. m.</i>		
African migratory grasshopper (<i>Locusta migratoria</i>)			Lopata, Fenemore et al., 2005	3+; Cross-sectional	10	3 (30)	4/10	40	4/10	40	4/10	40	0/10		4/10	40	6/10	60	nd		nd		nd							7/9	77.8	5/10	50	Scientists and technicians in research facility. 3/4 asthmatic subjects sensitized	
Mealworm (larva of beetle <i>Tenebrio molitor</i>), order Coleoptera	(*)	5	Barnstein, Gallagher et al., 1983	3+; case series	5	2 (40)	2/5	40	4/5	80	2/5	40	nd		1/5	20	4/5	80	nd		nd		2/2*	100	2					4/5	80	2/5	40	Fish bait handlers. *SIC done in asthmatics only; both asthmatics sensitized	
			Rudolph, Kunkel et al., 1979	3; case reports	3	2 (66.6)	2/3	66.6	3/3	100	3/3	100	nd		nd		3/3	100	1/2	50	nd		nd						3/3*	100	nd	nd	Animal breeders. *IC		
			Friedrich, 1986	3; case report	1	1	1/1		1/1		1/1		nd		nd		1/1		nd		nd		1/1		1				1/1*		1/1		Zoologist. *IC; nasal Ch+		
			Schroederstein, Meier-Davis et al., 1990	3; case report	1	0	0/1		1/1		1/1		nd		nd		1/1		nd		nd		nd						1/1		1/1		Animal handler. Cross-reactivity to <i>A. diaperinus</i> was confirmed by RAST-inhibition assays		
Mexican bean weevil (<i>Zabrotes subfasciatus</i> boh.), order Coleoptera	-	2	Wittich, 1940	3; case reports	2	2	2/2		2/2		2/2		1/2		nd		2/2		nd		nd		nd						2/2*		nd		Bean sorters. *IC; 1/1 nasal Ch+ and 1/1 conj. Ch+		
Mosquito larvae (<i>Echinodorus plamosus</i>)	-	1	Resta, Foschino-Barbaro et al., 1982	3; case report	1	1	1/1		1/1		1/1		1/1		nd		1/1		nd		nd		1/1		1				1/1		1/1		Aquarium keeper		
Non-biting midges (<i>Chironomus thummi thummi</i>), main allergen <i>Chi t 1</i>	*	34	Liebers, Hoernstein et al., 1993	2-; cross-sectional (retrospective)	225	34 (15.1)	37/225	16.4	54/225	24	52/225	23.1	nd		33/225	14.7	77/225	34.2	nd		nd		nd						51/94	54.3	76/225	33.8	Aquarists and workers in a fish-food factory. 34/37 asthmatics IgE+; IgE sign. associated with WRS; also association between symptoms and degree of exposure		
Screwworm fly (<i>Cochliomyia hominivorax</i>)	[*]	10	Gibbons, Dille et al., 1965	3+; cross-sectional	182	10 (5.5)	+		+		+		+		nd		46/182*	25.3	nd		nd		nd						10/11**	90.9	nd		Workers of the screwworm fly eradication program. *Indicated is the prevalence of symptoms (primarily cough, wheezing and shortness of breath), individual figures not listed; **SPT+ were all symptomatic		
Sewer fly (<i>Psychoda alternata</i>)	-	1	Gold, Mathews et al., 1985	3; case report	1	1	1/1		1/1		1/1		nd		nd		1/1		0/1		nd		nd					1/1		1/1		1/1	Worker at a sewage treatment plant. SPT+ with wax moth, deer fly, black fly, mosquito and cockroach; HR+; PK+		
Silkworm (<i>Bombyx mori</i>), silk, sericin	*[*]	35	Harindranath, Prakash et al., 1985	3+; survey	243	29 (11.9)	41/243	16.9	nd		nd		nd		nd		41/243	16.9	nd		nd		nd						70/243	28.8	13/15*	86.6	Workers of 2 silk filatures. *IgE with silkworm cocoon; 12/15 IgE+ with pupa; 29 asthmatics SPT+		
			Uragoda and Wijekoon, 1991	3+; cross-sectional	53	4 (7.5)	18/53	34	nd		nd		26/53	49.1	nd		30/53	56.6	nd		nd		4/18*						nd		nd		Silk processing workers. *PEFR in asthmatics		
			Charpin and Blanc, 1967	3; case reports	2	2	2/2		2/2		nd		nd		nd		2/2		nd		nd		nd					1/1		nd		nd	Hairdressers		
Various insects <i>Ephesia kuehniella</i> <i>Chrysoperla carnea</i> <i>Lepidotarsa decemlineata</i> <i>Ostrinia nubilalis</i>	-	3	Lugo, Cipolla et al., 1994	3+; cross-sectional	13	3 (23.1)	3/13	23.1	6/13	46.2	2/13	15.4	nd		1/13	7.7	7/13	53.8	nd		nd		nd						nd		8/13*	61.5	61.5	Employees in a production of beneficial arthropods. *All symptomatics IgE+ with at least one insect	
Various insects/Grain pests <i>L. destructor</i> <i>D. pteronyssinus</i> <i>D. farinae</i> <i>T. molitor</i>	-	31	Armentia, Martinez et al., 1997	3+; cross-sectional	50	31 (62)	31/50*	62	40/50	80	15/50	30	nd		2/50	4	nd		nd															Sensitization shown by SPT, RAST and SIC 19/50 (38) 29/50 (58) 24/50 (48) 25/50 (50)	
																																		bakers, farmers, factory workers with daily contact with cereal and suffering from work-related nasal or pulmonary symptoms. *Most of them sensitized.	

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							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE							
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total						Reaction												
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%	n/n LFT	%	n/n NSBHR	%	n/n PFT	%	n/n SIC	%		i	l	(n)	d	(n)	n/n SPT	%	n/n IgE
CRUSTACIANS (CRUSTACEA)																																			
Water-flea (<i>Daphnia</i>)	-	2	Meister, 1978	3; case reports	2	2	2/2		2/2		nd		1/2		1/2		2/2		1/1		nd		nd		1/1		1			2/2*		nd	Workers in the fish food store. *1/1 IC+ and 1/1 SPT+		
Lobster (<i>Family Nephropidae</i>)	-	2	Lemière, Desjardins et al., 1996	3; case report	1	1	1/1		1/1		nd		1/1		1/1		1/1		0/1		1/1		nd		1/1		1			1/1*	1/1*	Worker in a fishmonger shop, co-exposed and co-sensitized to shrimp. *SPT+ also with shrimp and clam; **IgE+ also with shrimp, crab, and crawfish; see also shrimp			
			Patel and Cockcroft, 1992	3; case report	1	1	1/1		nd		nd		1/1		1/1		1/1		1/1		1/1		nd		1/1		1			1/1	nd	Restaurant chef			
Prawn (<i>Nephrops norvegicus</i>), Norway lobster	**	22	McSharry, Anderson et al., 1994	2+; case control	26	15 (57.7)	26/26	100	3/26	11.5	3/26	11.5	17/26	65.4	13/26	50	26/26	100	15/26	57.7	nd		nd		nd					nd	15/26	57.7	Seafood-processing factory workers with respiratory symptoms. IgE+ sign, associated with duration of exposure and duration of symptoms		
			Gaddie, Legge et al., 1980	2-; cross-sectional	50	7 (14.0)	18/50	36	11/50	22	9/50	18	17/50	34	6/50	12	18/50	36	12/18	66.7	nd		nd		2/2		1	1		13/50	26	8/50	16	Prawn processors. 7/18 asthmatics SPT+ and IgE+, the other 11 asthmatics were not sensitized	
Shrimp (Order Decapoda)	[*]	5	Desjardins, Malo et al., 1995	3+; cross-sectional	57	1 (1.8)	2/57	3.5	3/57	5.3	nd		nd		nd		nd		nd		4/8*		nd		1/3*		33.3	1		9/57	15.8	8/55	14.5	Food company workers including index case, co-exposed to clam. *NSBHR and SIC in sensitized only; 1/2 asthmatics during shrimp-production period was SPT+, IgE+ and SIC+ to shrimp; see also clam	
			Lemière, Desjardins et al., 1996	3; case report	1	1	1/1		1/1		nd		1/1		1/1		1/1		0/1		1/1		nd		1/1		1			1/1*	1/1**	Worker in a fishmonger shop, co-exposed and co-sensitized to lobster. *SPT+ also with lobster and clam; **IgE+ also with lobster, crab, and crawfish; see also lobster			
			Goetz, Whisman et al., 2000	3; case report	1	1	1/1		nd		nd		1/1		1/1		1/1		nd		1/1		1/1		1/1		1			1/1	1/1	Restaurant seafood handler. See scallop			
<i>Gammarus</i>			Baur, Huber et al., 2000	3; case report	1	1	1/1		nd		nd		1/1		1/1		1/1		1/1		1/1		nd		1/1		1			1/1	1/1	Employee in a fish-food factory. Also IgE+ with <i>Chi t</i> 1-9 of <i>C. thummi</i>			
Shrimp meal (<i>Penaeus</i> shrimp, brine shrimp <i>Artemia salina</i>)			Carino, Elia et al., 1985	3; case report	1	1	1/1		1/1		nd		1/1		1/1		1/1		0/1		1/1		nd		1/1			1	1/1	1/1	1/1	Technician for experimental aquaculture			
Snow crab (<i>Chionoecetes opilio</i>)	**	30	Ortega, Darowalla et al., 2001	2-; longitudinal study	107	3 (2.8)	28/107	26.2*	nd		nd		nd		nd		nd		4/91**	4.4	8/91	8.8*		nd						nd	2-12/96**	2-12	Crab processing workers over the course of 1 processing season. *Incidence; **end of the season; sign. change in prevalence of the asthma-like symptom complex was observed over the season; 3 asthmatics had IgE+		
			Cartier, Malo et al., 1984	2-; cross-sectional	303	27 (8.9)	64/303	21.1	+		+		nd		72/303	23.8	nd		13/298	4.4	62/114	54.4	12/14**		33/46	71.7	1	23	9	65/298	21.8	nd	Snow crab processors. *55/303 (18.2%) WR rhinitis and/or conj.; **Serial PEFR before and after return to work; SIC, PFT, BHR in asthmatics only; 46 had OA, defined as +SIC (n=33) or at least 2 of the following: sign.changes in PEFR, PC20 and/or FEV1 on return to work (n=13); 27 of 46 subjects with OA were SPT+		
MOLLUSKS (MOLLUSCA)																																			
Clam (<i>Class Bivalvia</i>)	-	2	Desjardins, Malo et al., 1995	3+; survey	57	2 (3.5)	2/57	3.5	4/57	7.0	nd		nd		nd		nd		nd		4/8*		nd		2/2*		100	1	1	1	4/57	7.0	4/55	7.3	Food company workers including the index case, co-exposed to shrimp. *BHR and SIC in sensitized subjects only; both asthmatics during clam-production period were SPT+, IgE+ and SIC+ to clam; see also shrimp
Cuttle-fish (<i>Sepia apama</i>)	-	1	Tomaszunas, Weclawik et al., 1988	3+; case series	66	[61 (92.4)]	61/66*	92.4	nd		5/61*		nd		8/61*		66/66	100	nd		nd		nd		nd					nd	nd	nd	Deep-sea fishermen. *Respiratory symptoms were atopic bronchial asthma or spastic bronchitis. Of affected workers, 5 had also conjunctivitis and 8 had skin symptoms.		
			Baltrami, Innocenti et al., 1989	3; case report	1	1	1/1		nd		nd		1/1		1/1		1/1		nd		nd		nd		1/1			1	1/1	1/1	nd	nd	Goldsmith. Clinical tests done with cuttle-fish bone dust		
Green-lipped mussel (<i>Perna canaliculus</i>)	-	-	Glass, Power et al., 1998	2-; cross-sectional	223	[26 (11.7)]	51/223*	22.9	nd		nd		nd		nd		72/223	32.3	26/223	11.7	nd		4/19**		21.1					nd	nd	nd	Mussel openers at 9 processing sites. *WR wheeze; **PFT done in 1 of 9 sites; duration of work sign. associated with WRS; obstructive symptomatic subjects not listed		
Scallop (<i>Family Pectinidae</i>)	-	1	Goetz, Whisman et al., 2000	3; case report	1	1	1/1		nd		nd		1/1		1/1		1/1		nd		1/1		1/1		1/1		1			1/1	1/1	Restaurant seafood handler. Co-exposure to shrimp; significant cross-reactivity between scallop and shrimp			

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							WORK-RELATED SYMPTOMS														LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE		
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	n/n SIC	Reaction			n/n SPT	%	n/n IgE	%		
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%								i	(n)						(n)	d
Octopus (<i>Order Octopoda</i>)	-	1	Rosado, Tejedor et al., 2009	3; case report	1	1	1/1																										Worker in a canning fish and shellfish factory * SPT+ also for raw squid, raw shrimp and cat dander.	
SPONGES (PORIFERA)																																		
Marine sponge, powdered (<i>Dysidea herbacea</i>)	-	1	Baldo, Krilis et al., 1982	3; case report	1	1	1/1		nd	nd	nd	1/1	1/1	1/1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	1/1	Laboratory worker. Also IgE+ with 7 other sponge and 2 soft coral species; HR+ with <i>D. herbacea</i>	
CNIDARIA																																		
Red soft corals (<i>Dendronephthya nipponica</i>)	[*]	9	Onizuka, Inoue et al., 1990 ABSTRACT	3+; survey with index cases	2	2	2/2		-	-	-	-	2/2	-	-	-	-	-	-	-	-	-	-	-	2/2	-	-	-	-	-	-	2 spiny lobster fishermen with OA		
SPINAL CORDS (CHORDATA), VERTEBRATA																																		
FISH (PISCES)																																		
Atlantic Salmon (<i>Salmo salar</i>)	**	28	Shiryayeva, Aasmoe et al., 2010	3+; cross-sectional	139	2 (2.2)*	10/139	7.2	28/139*	20.1	nd			8/139	5.7	12/139	8.6	nd		**		nd		nd							2/89	2.2	Salmon-processing workers. *not indicated but probably asthma symptoms as well as sensitization **Higher prevalence of reduced LFT (FEV1 < 80% and FVC < 80%) in salmon-workers than in control. No reliable relation between asthma diagnose and occupation in salmon industry but significant higher prevalence of respiratory symptoms (wheezing, shortness of breath, coughing)	
Atlantic Salmon (<i>Salmo salar</i>)			Douglas, McSharry et al., 1995	2+; cross-sectional	291	15 (5.2)	70/291	24.1	+		nd		+		nd	121/291	41.6	nd		nd		24/291*	8.2	nd							25/291	8.6	Employees of a salmon-processing plant. *Prevalences of indiv. WRS not listed; **serial PEFR over several weeks: 24 subjects showed marked changes in daily mean PEFR levels, of whom 15 were sensitized and had asthmatic WRS, the other 9 PFT+ not sensitized to salmon	
Seafood (hake, pilchard, rock lobster, squid, mussel, abalone, prawn)			Jeebhay, Lopata et al., 2000	3+; cross-sectional	8532	597/8532*	7	*	*		nd		6484/8532*	76	nd		nd		nd		nd		nd									Seafood processors in 38 workplaces. *Of all symptomatics (figures not listed) 7% had asthma, 15% RC and 78% skin symptoms		
Fishmeal: pickling, herring, cod, shell fish, plaice, eel, sardine, tunny-fish, salmon, shrimp, mussel			Droszcz, Kowalski et al., 1981	2+; cross-sectional	51	1 (2.0)	1/51	2.0	nd		nd		nd		2/51	3.9	3/51	5.9	17/51	33.3	nd		2/51**	1			12/51*	23.5	nd			Fish meal factory workers. *IC with a mix of 10 fish species; **nasal Ch induced a 20% decrease in FEV1 in asthmatic subject		
Trout, Rainbow			Sherson, Hansen et al., 1989	2+; cross-sectional	8	5 (62.5)	6/8	75	3/8	37.5	nd		7/8	87.5	nd	8/8	100	1/8		7/8		4/6*	66.7	nd						8/8**	100	Production workers from trout-processing factory. *PEFR at work, PFT was not done in 1 asthmatic with NSBHR+; **IgE done with trout-contaminated water containing 1 µg endotoxin/ml		
Turbot (<i>Scophthalmus maximus</i>)			Pérez Carral, Martín-Lázaro et al., 2010	3; case reports	3	3	3/3		3/3		3/3		nd		2/3		nd		nd		'3/3		3/3						3/3	3/3		Fish-farm workers		
Fish: anchovy, Atlantic pomfret, hake, plaice, salmon, sardine, sole, trout, tuna			Rodríguez, Reaño et al., 1997	3; case reports	2	2	2/2		1/2		1/2		1/2		nd		2/2		nd		1/1		2/2*		2/2		2		2/2	2/2		Fish-processing workers. *Serial PEFR for periods of 2 weeks at work and off-work; subject 1: SPT+ with raw and cooked plaice, salmon, hake, tuna; IgE+ with salmon; SIC+ with raw hake, salmon, plaice, tuna; subject 2: SPT+ with raw and cooked anchovy, sardine, trout, salmon, sole, Atlantic pomfret; IgE+ with trout, anchovy, salmon; SIC+ with raw salmon		
BIRDS (AVES)																																		
Budgerigar (<i>Melopsittacus undulatus</i>)	[*]	5	Faux, Wide et al., 1971	3+; survey	118	5 (4.2)	14/118	11.9	nd		nd		nd		75/118*	63.5	nd		nd		nd		3/3**	'100	2	1	1	8/59***	13.6	22/59	37.3	Budgerigar fanciers. *Total symptoms of asthma, allergic alveolitis etc.; 3/14 asthmatics underwent SIC, 2/3 were sensitized; ***SPT and IgE done in 59 symptomatics; 5/6 tested asthmatics were SPT+ and IgE+ with budgerigar serum		

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							WORK-RELATED SYMPTOMS												LFT		NSBHR		sPFT		SIC				SPT			Spec. IgE		
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction				n/n SPT	%		n/n IgE	%	
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%	i	n						l
			Toorenenbergen van, Gerth van Wijk et al., 1985	3+; case series	154	-*	*		*		nd		nd		nd		154/154	100	nd		nd		nd		nd		nd		28/154	18.2	*154 budgerigar fanciers with asthma and/or rhinitis (and with no signs of hypersensitivity pneumonitis); see also canary			
Canary (<i>Serinus canaria</i>)	-		Toorenenbergen van, Gerth van Wijk et al., 1985	3+; case series	98	-*	*		*		nd		nd		nd		98/98		nd		nd		nd		nd		25/98	25.5	*98 canary fanciers with asthma and/or rhinitis (and with no signs of hypersensitivity pneumonitis); see also budgerigar					
Various birds: hen, duck, goose, parrot	[*]	17	Krakowiak, Palczynski et al., 2002	3+; cross-sectional	68	1 (1.5)	1/68	1.5	5/68	7.4	6/68	8.8	nd		nd		nd		*		nd		nd		15/68**	22.1	5/15***	33.3	Zoo workers, co-exposure and co-sensitization to animal fur. *Individual results not listed; **SPT with feather extract; ***IgE in SPT+					
Various birds: pigeon, budgerigar, parrot, finches and others			Hargreave and Pepps, 1972	3+; case series	81	10 (19.8)	10/81	12.5	nd		nd		nd		39/81	48.2	18/36*	50	nd		nd		36/81	44.5	5	27	4	16/36*	44.5	nd	Bird fanciers. *LFT and SPT were done in 36 SIC+ subjects; 8/9 subjects with immediate reaction to SIC were SPT+, 7/27 subjects with late reaction to SIC were SPT+			
Various birds: budgerigar, parrot, canary			Tauer-Reich, Fruhmann et al., 1994	3+; case series	5	5	5/5		2/5		1/5		nd		5/5		2/5		5/5		nd		nd		nd				5/5*		Bird fanciers. *IgE with sera and feathers; SDS-PAGE: cross-reactivity between serum and feather allergen of diff. bird species			
Various birds: pigeon, chicken			Hoffman and Guenther, 1988	3; case report	1	1	1/1		1/1		1/1		nd		1/1		nd		nd		nd		nd		1/1*				1/1**		Worker raising chicken, pheasants, quails and doves. *SPT+ with egg and feathers; **IgE+ with pigeon and chicken serum, with chicken meat and yolk			
Various birds: parrot, pigeon, canary and others			Świdarska-Kielbik, Krakowiak et al., 2009	3; survey	200	[7 (4.2)]	7/200	4.2	33/200	16.5	27/200	13.5	20/200	10	12/200	12	nd		nd		nd		nd		nd		nd		nd		Zoo bird keepers; only questionnaire survey. Co-exposure to various birds, latex and disinfectants. The latter were not associated with work-related symptoms. More work-related symptoms in contact with parrots (67%).			
Poultry			[*]	18																														
Poultry	Radon, Danuser et al., 2001	3+; survey			214	[13 (12.4)]	13/104	12.4	21/104	20.0	nd		25/104	24	nd		nd		nd		nd		nd		nd		nd		nd		Questionnaire survey of 7,496 animal farmers, 214 poultry farmers were included, 104 had work-related respiratory symptoms. not confirmed by allergy test results			
Poultry	Kimbell-Dunn, Bradshaw et al., 1999	3+; survey			23	*	4/23	17.4	nd		nd		8/23	34.8	nd		nd		nd		nd		nd		nd		nd		nd		Questionnaire survey of 1,706 farmers; 23 poultry farmers were included. *17.4% suffered from asthma, no allergy tests were made			
Poultry allergens	Bar-Sela, Teichtahl et al., 1984	3+ case series			16	13 (81.25)	14/16	87.5	15/16	93.75	nd		nd		16/16	100	10/14	71.4	nd		nd		1/1*	100	1			13/16**	81.25	10/16**	62.5	Symptomatic poultry workers. *SIC done with northern fowl mite; **with at least one poultry allergen; 13/14 asthmatics sensitized to at least one poultry allergen; none of the asymptomatic exposed controls was sensitized		
chicken droppings					2/16	12.5	9/12	75																										
chicken feathers					3/16	18.75	6/16	37.5																										
chicken serum					3/16	18.75	3/16	18.75																										
Northern fowl mite	9/16	56.25	10/16	62.5																														
poultry feed	8/16	50	7/12	58.3																														
Chicken and turkey	Perfetti, Cartier et al., 1997	3; case reports	4	4	4/4		3/4		3/4		nd		4/4		nd		4/4*		nd		nd		4/4**	100	nd				Poultry-slaughterhouse workers. **SPT with feathers; *FEV1 at work and off-work					
Chicken and turkey	Schwartz, 1994	3; case report	1	1	1/1		1/1		1/1		1/1		1/1		0/1		nd		nd		nd		1/1*		nd				Food processing. *SPT+ with raw chicken and raw turkey					
AMPHIBIANS (AMPHIBIA)																																		
Bull frog (<i>Rana catesbeiana</i>)	-	2	Nakazawa, Inazawa et al., 1983	3; case report	1	1	1/1		nd		1/1		1/1		1/1		0/1		nd		nd		nd		nd		nd		1/1		Laboratory technician handling frog brains			
Frog (<i>Rana esculenta</i>)			Armentia, Martin-Santos et al., 1988	3; case report	1	1	1/1		1/1		nd		nd		1/1		nd		nd		nd		1/1*		1/1*					Frog catcher with prev. diagn. of seasonal asthma. *Clinical tests with venom extract				
MAMMALS (MAMMALIA)																																		
Black bat (<i>Tadarida [chaerophon] major</i>)	(*)	9	El-Ansary, Gordon et al., 1987	3+; case series	7	7	7/7		6/7		nd		nd		7/7		nd		nd		nd		7/7*	100	7/7*	100			6 employees and 1 housewife exposed to bat droppings from cracked ceiling in Sudan. *Clinical tests with bat guano/droppings					
Bat			Senti, Lundberg et al., 2000	3; case report	1	1	1/1		1/1		1/1		1/1		1/1		0/1		0/1		nd		nd		1/1		1/1				Zoologist. Clinical test with bat guano; co-exposure and co-sensitization to <i>Tenebrio molitor</i> (bat feed)			

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							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE				
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction			n/n SPT	%	n/n IgE	%	
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%						i
Bat (Chiroptera)			Spiewak, Johansson et al., 1996	3; case report	1	1	1/1		nd		nd		nd		1/1		nd		nd		nd		1/1		1/1		Bat scientist. Clinical tests with bat hair					
Cow (<i>Bos primigenius taurus</i>)	*[*]	84	Walusiak, Krawczyk-Adamus et al., 2004	2+; case-control	100	[10 (10)]*	38/100	38	41/100	41	38/100	38	83/100	83	nd		100/100		nd		nd		11/100**				7/41***	4/41***	Farmers. Sign. risk factor of 38 OA cases was SPT+ to storage mites and cereals. *10 asthma cases inducted as be due to cow, individual sensitization not listed. **SIC+ or nasal challenge + with cow; ***SPT+ and IgE+ with animal allergens in symptomatics.			
* Farming (Cow dander, storage mites, fodder yeast, grains)			Terho, Vohlonen et al., 1987	3+; survey	208		+	+	0/208		0/208		0/208		136/208	65.4	nd		nd		nd		+		+	nd		*Selected 136 symptomatic (asthma and/or rhinitis) and 72 asymptomatic dairy farmers. **SPT done in 121 symptomatics and 64 asymptomatics, mean weal areas for cow dander and fodder yeast (<i>C. utilis</i>) were sign. larger in symptomatic farmers				
Cow (<i>Bos primigenius taurus</i>)			Terho, Husman et al., 1985	3+; survey	106	-	*		*86/106	81.1	nd		nd		86/106	81.1	nd		nd		nd		**		+	nd	nd	106 non-smoking dairy farmers. *86/106 had rhinitis or rhinitis together with asthma, individual symptoms not listed. **83 nasal Ch+ to storage mites and 10/70 nasal Ch+ to cow dander; all nasal challenge positive subjects were symptomatic				
*			Hinze and Bergmann, 1995	3+; case series	67	31 (83.8)	67/67	100	39/64	60.9	39/64	60.9	46/64	71.9	22/64	34.4	67/67	100	x*		32/35	91.4	nd		31/37**	83.8		59/61***	96.7	33/40***	82.5	Retrospective analysis of 67 asthmatics sensitized with cow hair: 64 farmers and 3 veterinarians. *Mean FEV1/FVC 57.4%; **type of reaction not listed; ***IgE and IC done with cow dander
*			Ylönen, Mäntyjärvi et al., 1992	3+; case serie	49	49 (100)	49/49	100	nd		nd		nd		49/49	100	nd		nd		nd		49/49*	100		x**	x**		Dairy farmers with diagnosed bovine asthma. *Type of reaction not listed; **48/49 either IgE+ or SPT+; 30/51 IgE+ with BEA (bovine epithelial allergen), 26/51 IgE+ with BUA (bovine urinary antigen); sign. higher anti-BEA IgE			
Bovine animals (Cow etc.)			Virtanen, Vilhunen et al., 1988	3+; case series	41	4 (10)	4/33	12.1	9/33	27.3	nd		nd		nd		nd		nd		nd		nd		+			Dairy farmers from 18 family farms. *IgE+ with bovine epithelial and urinary antigens				
Deer: Whitetail deer (<i>Odocoileus virginianus</i>) and mule deer (<i>Odocoileus hemionus</i>)	■	1	Gillespie, Dahlberg et al., 1985	3+; case series	13	*	*	*	*	*	*	*	*	*	13/13		nd		nd		nd		13/13**		11/13**			Deer/elk exposed symptomatic subjects, including at least 1 professional hunting guide; *individual symptoms not listed; **SPT and IgE done with deer hair/dander; see also elk				
Deer (<i>Cervus elaphus</i> , <i>Capreolus capreolus</i>)			Nahm, Park et al., 1996	3; case report	1	1	1/1		1/1		nd		1/1		1/1		nd		1/1		1/1		1		1/1*	1/1		Farmer raising red deer. *SPT+ with dander from deer, goat, sheep, camel, cow, deer				
Roe deer (<i>Capreolus capreolus</i>)	■	2	Carballada, Sanchez et al., 2006	3; case reports	2	2	1/2*		2/2		2/2		nd		nd		nd		nd		nd		2/2		1/2**			Workers in an animal recovery center. Co-exposure to other animals. Cross-reactions to other animal allergens (mainly cow). Probable asthma with work-related symptoms of dyspnea, wheezing, cough, rhinocconjunctivitis and eye-edema. ** Patient with probable asthma had no Spe. IgE to roe deer but to mites with a history of mite allergy. Conjunctival provocation tests were positive to roe deer.				
Elk (<i>Cervus canadensis</i>)	■	-	Gillespie, Dahlberg et al., 1985	3+; case series	13	*	+	+	+	+	+	+	+	+	13/13		nd		nd		nd		13/13**		5/13**			Deer/elk exposed symptomatic subjects, including at least 1 professional hunting guide; *individual symptoms not listed; **SPT and IgE done with elk hair/dander; see also deer				
Gerbil (<i>Meriones unguiculatus</i>)	■	1	de las Heras, Cuesta-Herranz et al., 2010	3; case report	1	1	1/1		1/1		1/1		nd		nd		0/1		0/1		nd		1/1*		1/1*			Biologist working with gerbils; co-exposure to guinea pigs. *SPT+ and Spec.IgE+ for guinea pig.				
Guinea pig (<i>Cavia porcellus</i>)	■	3	Hanada, Shima et al., 1995	3+; case series	5	3 (60)	3/5	60	5/5	100	0/5	0	0/5	0	0/5	0	5/5	100	nd		nd		nd		5/5*	100	5/5*	100	Laboratory workers. *SPT and IgE-test done with urine, saliva and pelt allergens; 5/5 nasal Ch+ with urine			
Horse (<i>Equus ferus</i>)	■	-	Tuittuoglu, Atis et al., 2002	3+; cross-sectional	125	[18]	18/125*	14.4	53/125**	42.4	44/125**	35.2	nd		41/125**	32.8	nd		30/125***	24	nd		nd		16/125	12.8	nd		Grooms. *total asthma cases, 12 of 18 work-aggravated asthma, **not clear whether WRS; ***mean FEV1, FEV1/FVC and FVC sign. decreased in exposed; sensitized asthmatics not listed but sign. relation between asthma and sensitization to horse hair.			
Mink (<i>Mustela vison</i>)	■	1	Jimenez Gomez, Anton et al., 1996	3; case report	1	1	1/1		1/1		1/1		1/1		nd		1/1		1/1		1/1		1/1*	1	1/1*	0/1*		Worker at a mink farm. *Clinical tests with mink urine				
Monkey (Cotton top tamarin)	■	2	Petry, Voss et al., 1985	3; case reports	2	2	2/2		1/2		nd		nd		nd		2/2		nd		nd		nd		2/2*	2/2*		Research psychology professor and his assistant. *Clinical tests with monkey dander				

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							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE									
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction			n/n SPT	%	n/n IgE	%						
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%	i						(n)	(n)	d	(n)	n/n SPT
Mouse (<i>Mus musculus</i>)	[*]	8	Schumacher, Tait et al., 1981	3+; cross-sectional	121	4 (3.3)	5/121	4.1	29/121	24.0	14/121	11.6	nd	16/121	13.2	39/121	32.2	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	25/121	20.7	26/121	21.5	Workers in a biological research institute. Immunological test done with urinary proteins. 4/5 asthmatics SPT+				
			Newman Taylor, Longbottom et al., 1977	3; case reports	4	4	4/4		4/4		4/4		nd	4/4		4/4		nd	nd	nd	4/4*		3		1	4/4*		4/4*		4/4*		Laboratory workers co-exposed and co-sensitized to rats. *Clinical tests with urine; see also rats					
			Muñoz, Gómez-Ollés et al., 2007	3; case report	1	[1]	1/1		1/1		1/1		nd	nd		nd		0/1	1/1	0/1	1/1				1	nd	0/1		0/1		mouse serum mouse hair						
Pig farming <i>D. pteronyssinus</i> <i>D. farinae</i> <i>Lepidoglyphus destructor</i> Pig epithelium	-	4	Radon, Schottky et al., 2000	3+; case series	100	[44]	44/100*	44	nd	nd	76/100	76	nd	100/100	100	**	nd	***	nd	nd	nd	nd	nd	nd	nd	nd	37/99***	37	16/99	16	14/99	14	12/99	12	2/99	2	100 pig farmers claiming compensation for occupational airway disease. *Wheezing, 69/100 shortness of breath; **sign, LFT decrease during the feeding period in the morning, not in the afternoon.***37/99 IgE+ to at least 1 allergen; 15/99 IgE+ to at least 1 animal allergen; 18/99 IgE+ to at least 1 mite allergen
Pig (Order Sus)			Labreque, Coté et al., 2004	3; case reports	2	2	2/2		2/2		2/2		nd	2/2		0/2	1/2	nd	2/2*		2			2/2*		nd		nd		nd		Pork processing workers. *With pork extract					
			Dosman, Lawson et al., 2004/2006	3+; case series	7	[7]	7**		nd	nd	7***		nd	nd		0/6**	2/5	nd	nd	nd	nd				0/7		nd		nd		nd		Workers in swine confinement facilities. The diagnose of occupational asthma is based on reference to the guidelines of American College of Chest Physicians, not confirmed by allergy tests. ***Asthma described as onset of wheezing and cough. ***First 4 cases had normal FEV1, FVC and FEV1/FVC, in the last 2 only FEV1 was indicated.				
			Harries and Cromwell, 1982	3; case report	1	1	1/1		nd	nd	nd		1/1	1/1		nd	nd	nd	1/1		1			1/1*		1/1**		1/1**		1/1**		Agricultural sciences student. *SPT+ with pork extract and with urine, IgE+ with urine					
			Brennan, 1985	3; case report	1	1	1/1		nd	nd	1/1		nd	1/1		1/1	nd	1/1*	nd	nd				nd		1/1**		1/1**		1/1**		Butcher. *Serial PEFR off-work for 1 week and at work for 1 week; **IgE+ with pig urine and pig skin					
Reindeer (<i>Rangifer tarandus</i>)	-	1	Reijula, Halmepuro et al., 1991	3+; cross-sectional	216	1 (0.5)	1/211	0.5	nd	nd	nd		nd	nd		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	1/216*	0.5	10/104	9.6	Reindeer herders. *SPT+ in one with pos. case history							
Rat (<i>Rattus norvegicus</i>)	**	89	Cullinan, Cook et al., 1999	2+; nested case-control	342	17 (5.0)**	36/342	10.5*	84/342	24.6*	nd		59/342	17.3**	103/342	30.1**	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	54/342*	15.8**	nd		Laboratory animal workers. Cohort study of 7 years and case-referent analysis within the cohort. *with urine; 46% of asthmatics SPT+; sign, exposure-response relationship with sensitisation and chest-symptoms within the first 2 years of exposure; **incidence in 3 years						
			Nieuwenhuijsen, Putcha et al., 2003	2+; cohort study	342	17 (5.0)	36/342	10.5	71/342	20.8*	+		47/342	13.7	101/342	29.5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	46/342	13.5	nd		Laboratory animal workers, same cohort like above. 17 asthmatics sensitized; strong association between intensity of exposure and WR respiratory symptoms among sensitized.						
			Hollander, Heederik et al., 1997	2; cross-sectional	398		*	*	*	*	*		78/398	19.6	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	69/398	17.3	44/398	11.1	Rat workers from 8 facilities. *Individual WRS not listed; 53/398 had rat allergy (WRS and sensitization to rat urinary protein and/or fur); sensitization, WRS and rat allergy sign, associated with the time-multiplied rat urinary allergen exposure in workers with less than 4 yr of exposure						
Rat (<i>Rattus norvegicus</i>)			Cullinan, Lowson et al., 1994	2; cross-sectional	323	10 (4.2)	32/323	9.9	71/323	22	71/323	22	0/323	48/323	14.9	98/323	30.3	nd	nd	nd	nd	nd	nd	nd	nd	nd	21/238**	8.8	nd		Cohort of laboratory animal workers in an initial cross-sectional phase of a longitudinal study						
							17/238*	7.1	32/238*	13.5	32/238*	13.5	0/238	25/238*	10.5	50/238*	21.0	nd	nd	nd	nd	nd	nd	nd	nd	21/238**	8.8	nd		*New WRS in subjects without previous exposure; **SPT done with rat urinary allergen; 10/17 asthmatics were SPT+							
			Hollander, Heederik et al., 1998	3+; cross-sectional	398	12 (5.7)	14/208	6.7	+	+	+	+	+	78/398	19.6	x*	nd	x**	nd	nd	nd	nd	nd	nd	nd	x***	x***				Laboratory workers working with living rats only (part of a cross-sectional study above). *Individual results not listed; **only 208 underwent PFT on work-days; PEFR sign, declined in asthmatics; ***70/398 (17.6%) sensitized to rat allergens, of whom 12 were asthmatics						
			Platts-Mills, Longbottom et al., 1987	3+; cross-sectional	179	13 (7.3)	18/179	10.1	30/179	16.8	nd		nd	30/179	16.8	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	22/179	12.3	17/179	9.5	Laboratory workers. SPT and IgE done with rat urinary protein. 13/18 asthmatics SPT+						

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							WORK-RELATED SYMPTOMS												LFT		NSBHR		sPFT		SIC				SPT			Spec. IgE		
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction				n/n SPT	%		n/n IgE	%	
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%	i	(n)						l
			Lieutier-Colas, Meyer et al., 2002	3+; cross-sectional	113	1 (0.9)	5/113	4.4	38/113	33.6	18/113	15.9	nd	nd	44/113	38.9	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	9/73*	12.3	Rat workers in 12 laboratories. *2/5 of asthmatics underwent IgE testing, 1/2 tested asthmatics IgE+
			Davies, Thompson et al., 1983	3+; case series	32	12 (37.5)	13/32		21/32		16/32		nd	11/32	24/32		3/29	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	20/32*	17/32*	Laboratory animal workers who previously reported allergic symptoms. *With urine; 12/13 asthmatics were SPT+ and IgE+		
			Newman Taylor, Longbottom et al., 1977	3; case reports	5	5	5/5		5/5		5/5		nd	5/5	5/5		nd	nd	nd	nd	5/5*		3	2	3/5*		2/5		1	1	3/5	2/5	Laboratory workers. Co-exposure and co-sensitization to mice. *with urine; see mice Rat serum	
Sheep (<i>Ovis aries</i>)	-	-	Radon and Winter, 2003	3+; cross-sectional	325	[68]	68/325*		nd		nd		57/325*	nd	124/325*	38.2	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Sheep breeders. *12 months prevalence and sign. increased WR respiratory symptoms (asthma and/or cough), work intensity and use of chemical footbath being the most important risk factors	
ANIMAL PRODUCTS																																		
Beef, raw	-	1	San-Juan, Lezaun et al., 2005	3; case report	1	1	1/1		0/1		0/1		0/1	1/1	1/1		nd	nd	nd	1/1		1							1/1*	1/1**		Cook. *SPT+ also with dog dander. **IgE done with dog dander; SDS-PAGE: cross-reactivity of dog dander with bovine serum albumin		
Bovine serum albumin (BSA) powder	-	-	Joliat and Weber, 1991	3; case report	1	[1]	1/1		1/1		1/1		nd	nd	1/1		0/1	nd	nd	1/1**		1							0/1*	nd		Laboratory technician co-exposed and co-sensitized to lab animals. *IC+ with BSA; **SIC+ with aqueous BSA		
Clam's liver	-	1	Karlin, 1979	3; case report	1	1	1/1		1/1		nd		1/1	nd	1/1		nd	nd	nd	1/1*									1/1**	nd		Drug research employee. *Reaction type not listed. **IC		
Endocrine glands (ovaries, testes, pancreas, adrenal glands) of bovine origine	-	1	Breton, Leneutre et al., 1989	3; case report	1	1	1/1		1/1		nd		nd	nd	1/1		1/1	nd	nd	1/1*		1						1/1	nd			Pharmacist. *SIC done with powdered bovine testes and adrenal glands		
Honey	-	1	Johnson, Dittrick et al., 1999	3; case report	1	1	1/1		nd		nd		1/1	1/1	1/1		0/1	1/1	1/1	1/1			1	1/1				1/1	1/1			Worker in a breakfast cereal-producing company		
Ivory (<i>Loxodonta africana</i>)	-	-	Armstrong, Neill et al., 1988	3; case report	1	[1]	1/1		nd		nd		nd	1/1	1/1		nd	nd	1/1*	1/1		1						0/1	nd			Worker in an ivory carving shop. *Serial FEV1 at work and off-work for 2 weeks		
Shark cartilage	-	1	Ortega, Kreiss et al. 2002	3; case report	1	[1]	1/1		nd		nd		1/1	1/1	1/1		nd	nd	nd	nd								nd	nd			Industrial mill worker with physician diagnosed and autopsy confirmed asthma		
Milk proteins																																		
Milk powder	-	4	Sripalboonkij, Phanprasit et al., 2008	2-; cross-sectional	167	[2 (1.2)]	2/167*	1.2	59/167**	35.3	55/167**	32.9	31/167**	18.6	42/167**	25.1	nd	x**	nd	nd	nd								nd	nd			Milk powder factory workers. *Physician diagnosed asthma within past 12 mo.; **symptoms within past 12 mo.; ***sign. decreased FEV1 in exposed	
Alpha-lactalbumin			Bernaola, Echechipia et al., 1994	3; case report	1	1	1/1		1/1		1/1		1/1	nd	1/1		0/1	1/1	nd	1/1		1						1/1	1/1			Chocolate candy maker. Conj Ch+		
Casein (main milk protein)			Olagubel, Hernandez et al., 1990	3; case report	1	1	1/1		1/1		nd		1/1	nd	1/1		nd	1/1	nd	1/1		1						1/1	1/1			Tannery worker		
Milk proteins			Rossi, Corsico et al., 1994	3; case report	1	1	1/1		1/1		1/1		1/1	nd	1/1		0/1	0/1	nd	1/1*		1						1/1**	1/1**			Delicatessen factory worker. *SIC+ with sodium caseinate, **SPT+ and IgE+ with lactalbumin and casein		
Milk proteins (casein, lactoglobulin)			Vargiu, Vargiu et al., 1994	3; case report	1	1	1/1		1/1		nd		nd	nd	1/1		nd	nd	nd	nd								1/1	1/1			Cattle farmer		
Egg proteins																																		
Egg white, lysozyme, ovalbumin, ovomucoid, egg yolk	**	36	Smith, Bernstein et al., 1990	2-; cross-sectional	188	14 (7.4)	58/188	30.9	nd		nd		nd	nd	58/188	30.9	nd	nd	19/86	22	nd							29/86	33.7	25/86	29	Employees of egg products production plant. 44/58 symptomatics and 44 asymptomatics underwent SPT, IgE, PFT; asthma cases defined by dual concordance between the physician diagnosis of asthma, WRS and SPT+ with ≥ 2 egg proteins		
Egg protein			Smith, Bernstein et al., 1987	2-; follow-up/cross-sectional ?	94	5 (5.3)	9/25*		nd		nd		nd	23/94	24.5	3/25	nd	5/25**	nd								8/21		4/19			25 egg workers from initial survey (n=94) were studied in detail. *Physician diagnosed asthma; **all 5 PFT+ were SPT+; 5 additional possible asthma cases among non-participants in the follow-up		
Egg proteins Conalbumin			Bernstein, Smith et al., 1987	2-; survey	25	5 (20)	6/25	24	0/25		0/25		0/25	0/25	6/25	24.0	nd	nd	6/25	24	nd						8/25	32.0	4/19	21.1	Workers in an egg-processing factory. 5 subjects had WRS asthma, PFT+ and SPT+ to at least 1 egg allergen			

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							WORK-RELATED SYMPTOMS												LFT		NSBHR		sPFT		SIC				SPT			Spec. IgE	
							Asthma	Rhinitis	Conjunct.	Cough	Skin	Total																					
n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%	n/n LFT	%	n/n NSBHR	%	n/n PFT	%	n/n SIC	%	i	(n)	l	(n)	d	(n)	n/n SPT	%	n/n IgE	%				
Family Araliaceae																																	
Umbrella tree (<i>Schefflera</i>)	■	1	Grob, Wüthrich et al., 1998	3; case report	1	1	1/1		1/1		1/1	nd	nd	1/1	nd	nd	nd	nd								1/1		1/1		Indoor gardener. Co-exposure and co-sensitization to <i>Ficus benjamina</i>			
Family Asclepiadaceae																																	
Madagascar jasmine (<i>Stephanotis floribunda</i>)	■	4	Zee van der, de Jager et al., 1999	3+; cross-sectional	34	4 (11.8)	4/34	11.8	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Greenhouse employees from 5 nurseries including 4 index cases. **5 subjects with "airway and skin symptoms" and 4 index cases with asthma; ***only symptomatics were IgE+		
Family Bombacaceae																																	
Kapok (<i>Ceiba pentandra Gaertner</i>)	■	-	Kern und Kohn, 1994	3; case report with follow-up	1	[1]	1/1		nd	nd	1/1	nd	1/1	1/1	nd	nd	nd*	1/1							1	0/1		0/1		Sewer. *0/9 PFT+ co-workers			
Family Brassicaceae (Cruciferae)																																	
<i>Arabidopsis thaliana</i>	■	1	Yates, De Soya et al., 2008	3; case report	1	1	1/1		nd	nd	1/1	nd	nd	0/1*	1/1	1/1	1/1	1							1/1		nd		Research student working with <i>A. thaliana</i> . *LFT showed a mild airway obstruction (about 16 % decrease in FEV1)/(FVC)				
Cabbage	■	1	Quirce, Madero et al., 2005	3; case report	1	1	1/1		1/1	1/1	1/1	1/1	1/1	0/1	0/1	nd	nd	nd							1/1		1/1		Kitchen supervisor co-exposed and co-sensitized to cauliflower. See cauliflower				
Cauliflower (<i>Brassica oleracea</i> var. Botrytis)	■	1	Quirce, Madero et al., 2005	3; case report	1	1	1/1		1/1	1/1	1/1	1/1	1/1	0/1	0/1	nd	1/1							1	1/1	1/1		Kitchen supervisor co-exposed and co-sensitized to cabbage. See cabbage					
Cauliflower (<i>Brassica oleracea</i> var. Botrytis) and Broccoli (<i>B. oleracea italica/cymosa</i>)	■	-	Hermanides, Lahey-de Boer et al., 2006	3+; cross-sectional	54	[2 (3.7)]	2/24	8.3	23/24	96	18/24	75	7/24	29	10/24	24/54	44	nd	nd	nd	nd				22/24*	96	14/24*	58	Employees in plant breeding. *SPT and RAST for the 24 workers with WRS. Sensitized asthmatics not listed.				
Oilseed rape flour	■	3	Alvarez, Estrada et al., 2001	3; case reports	3	2 (66.6)	3/3	100	3/3	100	3/3	100	0/3	0	0/3	0	3/3	100	0/3	0	3/3	100	2/3	66.6	2	3/3	100	3/3	100	Farmers handling animal fodder			
Oilseed rape (<i>Brassica napus</i> spp., oleifera)	■		Suh, Park et al., 1998	3; case report	1	1	1/1		nd	nd	1/1	nd	1/1	nd	0/1	nd	1/1	1						1/1		1/1	1/1		Employee in the animal feed industry.				
White wall rocket pollen (<i>Diplotaxis erucoides</i>)	■	1	Brito, Mur et al., 2001	3; case reports	2	1 (50)	1/2		2/2	2/2	1/2	nd	2/2	nd	1/1	1/1	1/1	1						2/2		2/2		2/2	Vineyard farmers				
	■		García-Ortega, Bartolome et al., 2001	3; case reports	3	0	0/3		3/3	3/3	nd	nd	3/3	nd	nd	nd	nd	nd						3/3		3/3		3/3	3 occupational exposed (vineyard workers) out of 410 allergic patients who underwent SPT with <i>D. e.</i> . 14/410 allergic patients were SPT+ to <i>D. e.</i> . 9/12 SPT+ subjects were nasal Ch+				
White mustard (<i>Sinapis alba</i>)	■	-	Angula, Palacios et al., 2007	3+; cross-sectional	12	[11 (91.6)]	11/12	91.6	12/12	100	nd	nd	nd	nd	nd	nd	nd	nd							12/12	100	12/12	100	Olive farmers. No pulmonological assessment except nasal challenge test (NCT). NCT+ in all farmers.				
Family Cactaceae																																	
Carnation (<i>Dianthus caryophyllus</i>)	■	1	Paulsen, Stahl Skov et al., 1997	3+; case series	5	1 (20)	1/5	10	3/5	60	2/5	40	nd	5/5	100	5/5	100	nd	nd	nd	nd					5/5	100	5/5	100	SPT and IgE+ with at least 1 cultivar of cactus			
Family Cannabaceae																																	
Hops (<i>Humulus lupulus</i>)	■	1	Newmark, 1978	3; case report	1	1	1/1		1/1	1/1	nd	1/1	1/1	nd	nd	nd	nd	nd							1/1*		nd		Brewery worker. *Scratch test+ with hops flowers				
Family Caryophyllaceae																																	
Baby's breath (<i>Gypsophila paniculata</i>)	■	3	Antépara, Jáuregui et al., 1994	3; case report	1	1	1/1		1/1	1/1	1/1	nd	1/1	1/1	0/1	nd	nd	nd	1/1					1	1/1		1/1		1/1	Florist			
	■		Schroockenstein, Meier-Davis et al., 1990	3; case report	1	1	1/1		1/1	1/1	1/1	nd	1/1	0/1	nd	nd	nd	1/1						1	1/1		1/1		1/1	Florist			
	■		Twiggs, Yunginger et al., 1982	3; case report	1	1	1/1		1/1	1/1	nd	nd	1/1	nd	nd	nd	nd	1/1						1	1/1		1/1		1/1	Florist			
	■		Vidal and Polo, 1998	3; case report	1	0	0/1		1/1	1/1	nd	1/1	1/1	0/1	0/1	nd	nd	nd	nd						1/1		1/1		1/1	Flower supplier co-exposed and co-sensitized to <i>Dianthus caryophyllus</i> and <i>Lilium longiflorum</i> ; see also <i>Dianthus caryophyllus</i> and <i>Lilium longiflorum</i>			

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							WORK-RELATED SYMPTOMS												LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE		
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction			n/n SPT	%	n/n IgE		%
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%	i					
Carnation (<i>Dianthus caryophyllus</i>)	(*)	15	Sanchez-Guerrero, Escudero et al., 1999	3+; case series	16	13 (81.25)	15/16	93.75	15/16	93.75	nd	nd	nd	1/16	6.25	16/16	100	nd	15/16	93.75	13/14*	92.8	nd					15/16	93.75	11/14	78.6	Employees in indoor carnation cultivation. *Serial PEFR for 2 weeks at work and 2 weeks off-work
			Cisteró-Bahima, Enrique et al., 2000	3; case report	1	1	1/1		nd	nd	1/1	nd	1/1		0/1		1/1	nd	1/1			1				1/1		1/1		1/1	Flower cultivator co-exposed and co-sensitized to <i>Tetranichus urticae</i> .	
			Sánchez-Fernández, González-Gutiérrez et al., 2004	3; case report	1	1	1/1		1/1	1/1	nd	nd	1/1		nd		1/1	nd	1/1				1			1/1		1/1		1/1	Flowershop worker.	
			Vidal and Polo, 1998	3; case report	1	0	0/1		1/1	1/1	nd	1/1	1/1		0/1		0/1	nd	nd							1/1		1/1		1/1	Flower supplier co-exposed and co-sensitized to <i>Gypsophila paniculata</i> and <i>Lilium longiflorum</i> ; see also <i>Gypsophila paniculata</i> and <i>Lilium longiflorum</i>	
Family Chenopodiaceae																																
Swiss chard (<i>Beta vulgaris</i> L. cycla)	-	2	Parra, Lázaro et al., 1993	3; case report	1	1	1/1		1/1	1/1	1/1	nd	1/1		0/1		1/1	nd	1/1						1	1/1		1/1		1/1	Housewife inhaling vapors of boiling Swiss chard	
			Hoz de la, Fernandez-Rivas et al., 1991	3; case report	1	1	1/1		1/1	1/1	nd	nd	1/1		0/1		1/1	nd	1/1			1				1/1		1/1		1/1	Housewife. HR+; oral Ch-	
Family Compositae=Asteraceae																																
Artichoke, globe (<i>Cynara scolymus</i>)	-	3	Miralles, Garcia-Sellés et al., 2003	3; case reports	2	2	2/2		2/2	0/2	0/2	1/2	2/2		0/2		nd	1/1	nd							2/2		2/2		2/2	Vegetable warehouse workers. 2/2 nasal Ch+	
			Quiroce, Tabar et al., 1996	3; case report	1	1	1/1		1/1	1/1	1/1	1/1	1/1		0/1		0/1	nd	0/1							1/1		1/1		1/1	Worker in a vegetable-processing plant	
Camomile (<i>Matricaria chamomilla</i>)	-	1	Rudzki, Rapiejko et al., 2003	3; case report	1	1	1/1		1/1	1/1	nd	1/1	1/1		nd		nd	nd	nd							1/1		nd		nd	Cosmetician co-exposed and co-sensitized to lime flower. *Nasal Ch+	
Chicory (<i>Cichorium intybus</i>)	-	4	Cadot, Kochuyt et al., 1996	3; case report	1	1	1/1		1/1	1/1	nd	1/1	1/1		nd		nd	nd	nd							1/1		1/1		1/1	Vegetable wholesaler	
			Nemery and Demedts, 1989	3; case report (letter)	1	1	1/1		1/1	0/1	1/1	1/1	1/1		1/1		1/1	1/1*	nd							1/1**		1/1**		nd	Chicory grower. *Serial PEF for 4 weeks; **patch (delayed reaction)	
			Escudero, Bartolomé et al., 1999	3; case report	1	1	1/1		1/1	nd	nd	1/1	1/1		0/1		1/1	1/1*	nd							1/1		1/1		1/1	Grocery store worker, co-exposed and co-sensitized to lettuce. *PEFR for 2 weeks; see lettuce	
			Pirson, Detry et al., 2009	3; case report	1	1	1/1		1/1	1/1	nd	nd	nd		0/1		1/1	nd	1/1			1				1/1*		1/1*		1/1*	Worker in a factory producing inulin from chicory. He developed an oral allergy syndrome to raw fruits and vegetables. *SPT+ for birch pollen, raw carrot, Greenhouse employees. Cross-reaction between C. and mugwort.	
Chrysanthemum (<i>Chrysanthemum</i>)	[*]	9	Groenewoud, Jong et al., 2002	3+; cross-sectional	104	8 (7.7)	8/104	7.7	50/104	48.1	27/104	26	nd	15/104	14.4	59/104	56.7	nd	nd	nd	nd					21/104	20.2	11/104	10.6	10.6	Greenhouse employees. Cross-reaction between C. and mugwort.	
			Pirilä, Keskinen et al., 1994	3; case report	1	1	1/1		nd	nd	nd	1/1	1/1		1/1		1/1	1/1*	1/1			1			1/1		1/1		nd	1/1	Florist. *Serial PEFR or FEV1 at home and at work	
Flowers (<i>Aster chinensis</i> , <i>Chrysanthemum koreanum</i> , <i>Dahlia cultorum</i> , <i>Solidago virgaurea</i> , and <i>Chrysanthemum leucanthemum</i>)	*	6	Akpınar-Elici, Elici et al., 2004	2-; cross-sectional	128	5 (3.9)	18/128	14.1	17/128	13.3	18/128	14.1	10/128	7.8	29/128	22.7	nd	0/128	nd	nd	nd					11/128*	8.6	nd		nd	Florists in 54 floral shops. *SPT with flower mix; 5/18 asthmatics SPT+; asthmatics were sign. more likely to have SPT+, risks for asthma were high work intensity and long work duration	
Flowers (dandelion, blazing star, golden rod, yarrow, <i>Aster</i> spp, <i>chrysanthemums</i> , <i>margerite</i>)			Uter, Nöhle et al., 2001 ABSTRACT	3; case report	1	1	1/1*		1/1		-	1/1	1/1		-		-	-	1/1**						1/1**		1/1**		1/1**	1/1**	Florist. *Late asthma; **SIC+, SPT+ and IgE+ to various members of the plant family Compositae	
Lettuce (<i>Lactuca sativa</i>)	-	1	Escudero, Bartolomé et al., 1999	3; case report	1	1	1/1		1/1	nd	nd	1/1	1/1		0/1		1/1	1/1*	nd						1/1		1/1		1/1	1/1	Grocery store worker, co-exposed and co-sensitized to chicory. *PEFR for 2 weeks; see chicory	
Marigold flour (<i>Tagetes erecta</i> , <i>Calendula officinalis</i>)	-	1	Lluch-Perez, Garcia-Rodriguez et al., 2009	3; case report	1	1	1/1		1/1	nd	nd	nd	nd		nd		nd	nd	nd						1/1		1/1		1/1	1/1	Porter in an animal fodder factory. Nasal challenge test was positive	

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							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE					
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction			n/n SPT	%	n/n IgE	%		
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%						i	(n)
Milk thistle (<i>Silybum marianum</i>)	■	1	Bircher and Wütrich, 1992	3; case report	1	1	1/1		1/1		1/1		nd		nd		1/1		nd		nd		nd		nd		nd		1/1		1/1		Pharmacy employee
Safflower (<i>Carthamus tinctorius</i>)	■	1	Compes, Bartelomé et al., 2006	3; case report	1	1	1/1		1/1		nd		1/1		1/1		0/1		1/1		nd		1/1		1		1/1		1/1		1/1		Instructor of personell making dried flower arrangements. See also yarrow
Sunflower pollen (<i>Helianthus annuus</i>)	★	3	Atis, Tutluoglu et al., 2002	2; cross-sectional	102	[17 (16.6)]	17/102	16.6	*	*		nd	*		nd		**		nd		nd		nd				24/102	23.5	nd			Sunflower processing factory. *Allergic symptoms (rhinitis, conj., skin) 29/102 (28.4%); ** LFT parameters significant lower in high exposed workers than in unexposed group; sensitized asthmatics not listed	
			Jiménez, Moreno et al., 1994	3+; case series	5	2 (40)	2/5	40	5/5	100	5/5	100	nd	2/5	40	5/5	100	nd		nd		nd		2/2	100	1	1	5/5	100	4/5	80	5 occupationally exposed workers handling sunflower pollen and 32 non-occupationally exposed	
			Bousquet, Dhivert et al., 1985	3; case report	1	1	1/1		1/1		1/1		nd	nd		1/1		nd		0/1		nd		1/1		1		1/1		1/1		Employee in the agricultural department	
Sunflower seeds	■	1	Vandenplas, Van der Borghet et al., 1998	3; case report	1	1	1/1		1/1		1/1		nd	nd		1/1		1/1		1/1		nd		1/1		1		1/1		1/1		Baker. Also SPT+ with alpha-amylase and SIC+ with flour	
Yarrow (<i>Achillea millefolium</i>)	■	1	Compes, Bartelomé et al., 2006	3; case report	1	1	1/1		1/1		nd		1/1		1/1		0/1		1/1		nd		1/1		1		1/1		1/1		1/1		Instructor of personell making dried flower arrangements. See also safflower
Family Cucurbitaceae																																	
Courgette (<i>Cucurbita pepo</i>)	■	1	Miralles, Negro et al., 2000	3; case report	1	1	1/1		1/1		1/1		nd		nd		1/1		nd		nd		nd				1/1		1/1		1/1		Worker in the fruit and vegetable warehouse. Nasal Ch+
Family Euphorbiaceae																																	
Castor beans (<i>Ricinus communis</i>)	[*]	16	Topping, Henderson et al., 1982	3+; cross-sectional	70	7 (10)	7/70	10	12/70	17.1	12/70	17.1	nd		nd		12/70	17.1	nd		nd		nd				12/20*	60	15/23*	65.2	Workers of felt (mixture of waste natural fibers) manufacturing plant. *SPT and IgE done with castor bean and felt in 23/26 subjects with suspected WRS; all symptomatics sensitized to castor bean and felt		
			Patussi, De Zotti et al., 1990 ABSTRACT	3+; case series	16	*	*	*	*	*	*	*	*	*	*	*	16/16		nd		nd		nd				15/16	15/15				*Workers with asthma or rhinitis handling green coffee beans in sacks which were contaminated with castor beans	
			Parzani, Johansson et al., 1986	3+; case series	15	2	13/15*	*		nd	nd	nd	nd	nd	nd	nd	15/15		nd		nd		nd				2/15	2/15				6 groups studied. 1 occupationally exposed; 15 SPT-symptomatic farmers handling castor bean fertilizer. *Asthma or allergic rhinitis	
			Davison, Britton et al., 1983	3+; case series	5	5	5/5		nd		nd		nd	nd	nd	5/5		0/3		nd		nd		2/3		2		nd	5/5			3 merchant seamen and 2 laboratory workers	
			Baur, Chen et al., 1998	3; case report	1	1	1/1		1/1		1/1		nd	nd		1/1		1/1		nd		nd		nd			1/1		1/1		1/1		Trader of agricultural goods (castor bean fertilizer)
			Merget, Heger et al., 1994	3; case report	1	1	1/1		1/1		nd		nd	nd		1/1		0/1		1/1		nd		1/1*		1		1/1		1/1		Agricultural products merchant. *SIC done with extract of castor bean fertilizer	
Copperleaf (<i>Acalypha wilkesiana</i>)	■	1	Perez, Blanco et al., 2006	3; case report	1	1	1/1		1/1		1/1		nd	nd		1/1		0/1		nd		nd		1/1		1		1/1		1/1		Gardener	
Latex (<i>Hevea brasiliensis</i>)	★★	136	Bousquet, Flahault et al., 2006	2+; systematic review of cross-sectional studies	9056	-	OR: 1.55		OR: 2.73				OR: 2.46		4.32													7.19		6.37		Health care workers. Sensitization sign. assoc. with asthma (OR 3.95) but exposure to latex was not associated with a sign.increased risk of positive SPT (OR 1.47)	
			Archambault, Malo et al., 2001	2+; prospective cohort study	122	5 (4.5)***	1/7*		2/7*		2/7*		nd	6/7*		nd		x**		5/110***	4.5	nd		nd			7/110***	6.4	nd			Apprentices in dental hygiene starting a program. *Symptoms listed for SPT+ subjects only; **0/7 in SPT+ subjects only measured at entry; ***all 5 with BHR+ were SPT+; cumulative incidence of probable OA (SPT+ and BHR+) 4.5% at 32 months after start of exposure, incidence density 5/282 person-years (1.8%); ****cumulative incidence 6.4%, incidence density 7/282 person-years (2.5%)	

Agents	Strength of evidence per agent (three star system of RCGP)	Total no. of allergic asthma cases per agent, n	Reference	Level of evidence per study (revised SIGN grading system); study type.	Occupationally exposed subjects studied, n	Allergic asthma cases due to mentioned agent, n, prevalence (%). Cases with probable allergic asthma but specific sensitization not confirmed in parentheses [] or not indicated.	EVIDENCE (pathological results)																												Remarks			
							WORK-RELATED SYMPTOMS														LFT		NSBHR		sPFT		SIC				SPT		Spec. IgE					
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n sPFT	%	Reaction				n/n SPT	%	n/n IgE	%						
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%	i	n					l	(n)		d	(n)	
			Lies, Sussman et al., 1997	2-; cross-sectional	1351	23 (1.7)	73/1351	5.4	119/1351	8.8	205/1351	15.2	66/1351	4.9	47/1351	3.5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Hospital workers. 23 asthmatics SPT+; sign. associations between SPT+ and WRS
			Chaiyar, Sadhra et al., 2001	3+; cross-sectional	814	-*	186/814	22.9	200/814	24.6	323/814	39.7	200/814	24.6	183/814	22.5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	500 latex glove factory workers and 314 latex tappers. *Sensitized asthmatics not listed but work-related respiratory and dermatological symptoms were not related to the presence of positive latex SPT.	
			Grzybowski, Ownby et al., 1996	2-; cross-sectional	741	[27 (3.6)]	27/741	3.6	99/741	13.4	96/741	13.0	nd	423/741	57.1	448/741	60.5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Registered nurses. 56 symptomatics IgE+; sensitized asthmatics not listed; WRS sign. associated with IgE+	
			Carrillo, Blanco et al., 1995	2-; cross-sectional	418	-*	-	-	-	-	nd	nd	nd	23/418	75/418	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Agricultural workers. *20/418 nasal and/or respiratory complaints; sign. association between sensitized symptomatics and duration of exposure		
			Hunt, Fransway et al., 1995	3; case series	342	43 (12.6)	43/104*	41.4	72/104*	69.2	66/104*	63.5	nd	81/104*	77.9	342/342	100.0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Health care workers with symptoms suggestive of latex allergy. *Individual WRS listed in SPT+ only; **IgE in SPT+		
			Vandenplas, Delwiche et al., 1995	3+; Cross-sectional	273	7 (2.6)	5/273	1.8	25/273	9.2	25/273	9.2	nd	19/273	7	nd	1/12*	12/12*	nd	7/12*	4	3	13/273	4.8	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Hospital employees. *Only sensitized subjects underwent clinical tests; in addition to 5 asthmatics 2 other subjects were SIC+, NSBHR+ and SPT+	
			Tarlo, Sussman et al., 1997	2-; cross-sectional	203	6 (3.0)	10/203	4.9	24/203*	11.8	+	+	nd	34/203	17	48/203	23.6	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Dental students and staff. *Rhinitis or conj.; **6/9 asthmatics SPT+, 1 asthmatic not tested; SPT+ sign. associated with asthma (WRS)	
			Baur, Chen et al., 1995	2-; cross-sectional	111	3 (2.7)	4/111	3.6	12/111	10.8	10/111	9	nd	26/111	23.4	32/111	28.8	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Hospital staff. WRS sign. associated with IgE+; 3/4 asthmatics sensitized	
			Tarlo, Wong et al., 1990	3+; cross-sectional with index case	81	3 (3.7)	42/69	60.9	52/69	75.4	nd	nd	nd	7/69	10.2	53/69	76.8	1/1	6/12	6/51	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Employees in a surgical glove manufacturing plant. Results include 1 index case; 3 subjects had asthmatic WRS, SPT+, BHR+, and PFT+; not all asthmatics underwent clinical tests	
			Zuskin, Mustajbegovic et al., 1998	2-; cross-sectional	17	1 (5.9)	8/17	47.1	nd	13/17	76.5	10/17	58.8	nd	nd	nd	*	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Employees of a latex glove manufacturing glove plant. *Sign. lower FVC, FEV1, FEF50, and FEF75; 1 subject had symptoms of OA (asthma and LFT+) and SPT+	
			Vandenplas, Binard-van-Cangh et al., 2001	3+; case series	45	31 (68.8)	36/45	80	43/45	95.5	nd	nd	nd	40/45	88.8	45/45	100	nd	44/45	97.7	nd	6/14*	68.8	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	45 latex exposed subjects. All SIC+ were also SPT+	
			Baur, Jäger et al., 1992	3+; case series	56	6 (10.7)	24/56	42.9	12/56*	21.4	+	+	nd	56/56	100	56/56	100	nd	nd	nd	6/23**	26.1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	SPT+ hospital personnel. *Rhinitis or conj.; **SIC only in asthmatics, reaction type not listed	
			Jäger, Kleinhans et al., 1992	3+; case series	70	5 (7.1)	22/70	31.4	36/70	51.4	31/70	44.2	nd	70/70	100	70/70	100	nd	nd	nd	5/18*	27.8	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Hospital personnel. *SIC in IgE+ symptomatics	
			Orfan, Reed et al., 1994	3+; survey with index case	22	2 (9)	2/22	9	2/22	9	2/22	9	nd	nd	2/22	9	nd	nd	nd	nd	1/1	1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Workers of a latex doll manufacturing plant. Results include index case	
			Anbarro, Seoane et al., 2010	3; case report	1	1	1/1	1	1/1	1	1/1	1	nd	nd	nd	nd	0/1	1/1	1/1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Butcher. Had no direct contact with latex, source were the coworkers latex gloves.	
			Bueso, Rodriguez-Perez et al., 2010	3; case report	1	1	1/1	1	1/1	1	1/1	1	nd	nd	nd	nd	0/1	nd	nd	nd	1/1	1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Worker in a cosmetic company	
Family Iridaceae																																						
			1	Toorenenbergen van and Dieges, 1984	3; case report	1	1	1/1	nd	nd	nd	nd	nd	1/1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Greenhouse worker. Clinical tests done with flower and stem	
			1	Pirilä, Keskinen et al., 1994	3; case report	1	[1]	1/1	nd	1/1	nd	nd	nd	1/1	0/1	1/1	1/1*	0/1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Gardener. *PEFR or FEV1 at home and at work	
			1	Fao, Martinez et al., 1997	3+; Cross-sectional	50	1 (2)	3/50	6	8/50	16	2/50	4	nd	4/50	8	nd	nd	1/1*	nd	1/1*	1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Saffron workers. *NSBHR and SIC in sensitized astmatic; 2/2 conj Ch+	
Family Lamiaceae																																						

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							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE					
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total						Reaction										
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%	n/n LFT	%	n/n NSBHR	%	n/n PFT	%	n/n SIC	%		i (n) l (n) d (n)	n/n SPT	%	n/n IgE	%	
Bells of Ireland, pollen of (<i>Molucella laevis</i>)	■	1	Miesen, van der Heide et al., 2003	3; case report	1	1	1/1		1/1		1/1		1/1		1/1		1/1		1/1		1/1		1/1		1/1		1/1		Greenhouse employee. 18% decline of FEV1 during seasonal exposure; *serial PEFR for 1 week				
Family Leguminosae																																	
Carob bean flour (<i>Ceratonia siliqua</i>)	■	3	Brempt van der Leident et al., 1992	3; case report	1	1	1/1		1/1		1/1		1/1		1/1		1/1		1/1		1/1		1/1		1/1		1/1		Employee in a jam factory co-exposed and co-sensitized to guar gum				
			Scoditti, Peluso et al., 1996	3; case report	1	1	1/1		nd		nd		1/1		0/1		1/1		nd		1/1		1		1/1		1/1		Ice cream maker				
Carob bean tree-St. John's bread seed			Bircher and Wütrich, 1992	3; case report	1	1	1/1		1/1		1/1		nd		1/1		nd		nd		1/1		1/1*		1/1		1/1		Ice cream production worker, co-exposed and co-sensitized to Tragacanth gum. *Scratch test; see Tragacanth gum				
Chick pea (<i>Cicer arietinum</i>)	■	1	Martin, Compaired et al., 1992	3; case report	1	1	1/1		1/1		nd		1/1		0/1		1/1		nd		1/1		1		1/1		1/1		Houseman, co-exposed and co-sensitized to lentil. HR+; see lentil				
Chickling vetch (<i>Lathyrus sativus</i>)	■	1	Valdivieso, Quirce et al., 1988	3; case report	1	1	1/1		1/1		nd		nd		0/1		1/1		nd		1/1		1		1/1		1/1		A 10-year-old child in the family store				
Green bean (<i>Phaseolus multiflorus</i>)	■	2	Igea, Fernandez et al., 1994	3; case report	1	1	1/1		1/1		1/1		nd		1/1		1/1		nd		1/1		1		1/1		1/1		Homemaker exposed to vapor of boiling green beans. SPT- with cooked green beans				
			Parra, Lázaro et al., 1993	3; case report	1	1	1/1		1/1		1/1		nd		0/1		1/1		nd		1/1		1		1/1		1/1		Housewife inhaling vapors of boiling GB, co-exposed and co-sensitized to Swiss chard.				
Guar gum (<i>Cyamopsis tetragonolobus</i>)	★	6	Malo, Cartier et al., 1990	2-; cross-sectional	162	3 (1.9)	37/162	22.8	59/162	36.4	nd		nd		17/162	10.5	nd		3/40	7.5	11/40*	27.5	0/5**		2/4***	50	2		8/162	4.9	11/133	8.3	Employees of a carpet manufact. plant. *NSBHR in symptomatics or sensitized only. **Serial PEFR for 2 weeks at work in SPT- and NSBHR+ subjects; ***SIC only in asthmatics. SPT+ and NSBHR+
			Lagier, Cartier et al., 1990	3; case reports	3	3	3/3		3/3		1/3		nd		3/3		1/1		3/3		2		1		3/3		3/3		1	3/3	3/3	1 pharmaceutical worker and 2 carpet-manufacturing workers.	
Gum arabic (<i>Acacia senegal</i>)	(*)	11	Bohner, Sheldon et al., 1941	3+; case series	10	10	10/10		nd		nd		nd		10/10		nd		nd		nd						10/10		nd		Printers		
			Sander, Rauf-Heimsoth et al., 2006	3; case report	1	1	1/1		1/1		1/1		nd		1/1		0/1		0/1		1/1		1		1/1		1/1		1/1		Pharmaceutical industry worker		
Lathyrus sativus flour	■	2	León, Martín Calderín et al., 2001	3; case report	1	1	1/1		1/1		nd		1/1		1/1		1/1		1/1		1/1		1		1/1		1/1		1/1		Worker in parquet processing.		
Lathyrus sativus flour			Gironés, de la Hoz Caballer et al., 2005	3; case report	1	1	1/1		1/1		nd		nd		0/1		1/1*		nd		1/1		1		1/1		1/1		1/1		Carpenter. *NSBHR was absent 24h before and present 72h after SIC.		
Lupine (<i>Lupinus albus</i>)	■	3	Campbell, Jackson et al., 2007	2-; cross-sectional	53	2 (3.8)	3/53	5.7	10/53	18.9	2/53	3.8	2/53	3.8	1/53	1.9	16/53	30.2	2/53	3.8	2/4		nd		1/1		1	11/53	20.8	nd		Workers in a food processing company. 7/11 sensitized workers had WRS. Out of 3 asthmatics, 2 had SPT+, 1 suffered from work-aggravated asthma.	
Lupine seed flour (<i>Lupinus albus</i>)			Crespo, Rodríguez et al., 2001	3+; cross-sectional	7	1 (14.3)	1/7	14.3	2/7	28.6	3/7	42.9	1/7	14.3	nd		3/7	42.9	nd		1/1		1/1		14.3	1		3/7	42.9	2/7	28.6	Employees at legume laboratories.	
Acacia (<i>Gum arabic</i>)	■	-	Fowler, 1952	cross-sectional	31	[6 (19.4)]	6/31	19.4					+				nd		nd		nd		nd		nd		nd		nd		12 additional printers had early symptoms of sensitisation		
				symptomatic subjects	32	[26 (81.3)]	26/32	81.3	+				+				32/32		nd		nd		nd		nd		1/1		nd		2 additional printers had early symptoms of asthma.		
Henna, black (<i>Indigofera argentea</i>)	■	1	Scibilia, Galdi et al., 1997	3; case report	1	1	1/1		1/1		1/1		1/1		1/1		1/1		1/1		1/1		1/1		1/1		1/1		1/1		Herbal shop worker.		
Lentil (<i>Lens culinaris</i>)	■	1	Martin, Compaired et al., 1992	3; case report	1	1	1/1		1/1		nd		1/1		0/1		1/1		nd		1/1		1		1/1		1/1		1/1		Houseman, co-exposed and co-sensitized to chick pea. HR+; see chick pea		
Liquorice roots, licorice (<i>Glycyrrhiza glabra</i>)	■	1	Cartier, Malo et al., 2002	3; case report	1	1	1/1		1/1		1/1		nd		1/1		1/1		1/1		1/1		1		1/1		1/1		nd		Herbalist co-exposed and co-sensitized to echinacea, nettle, hop, thistle		
Mimosa (<i>Acacia floribunda</i>)	■	4	Ariano, Panzani et al., 1991	3+; survey	106	4 (11.5)*	4/106	11.5*	29/106	78.5*	29/106	78.5*	nd		1/106		33/106*	31	nd		nd		nd		nd		33/106**		33/106**		Floriculturists. *Incidence in 9 years; **Results listed only for symptomatics		

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							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE					
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction			n/n SPT	%	n/n IgE	%		
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%						i	n
Pea, perennial (<i>Lathyrus odoratus</i>), sweetpea	-	2	Jansen, Vermeulen et al., 1995	3; case report	1	1	1/1		1/1		1/1		nd		nd		1/1		nd		1/1*		nd					1/1**		1/1***		Greenhouse worker. *Serial PEFR at work and off-work for 4 weeks; **SPT+ with whole plant; IgE+ with pollen	
Pea flour			Bhagat, Swystun et al., 1995	3; case report	1	1	1/1		nd		nd		1/1		nd		0/1		1/1		nd		nd				1/1		nd		Flour mill worker processing peas		
Senna and Ispaghula husks	*	6	Marks, Salome et al., 1991	2-; cross-sectional	125	4 (3.2)	10/125	8.0	+		+		nd		+		nd		4/119	3.4	9/112**	8	nd		nd				21/118**	17.8	nd	Pharmaceutical workers. *21/115 WR nose, eye, and skin symptoms; **NSBHR in LFT; ***SPT+ with ispaghula and/or senna; 9/118 SPT+ with ispaghula, 18/118 SPT+ with senna; 4 OA, defined as at least one WR respiratory symptom, SPT+ to at least one occupational allergen, and either NSBHR+ or BD+ or physician diagnosed asthma	
Senna (<i>Cassia angustifolia</i> , <i>Cassia acutifolia</i> or <i>Cassia senna</i>)			Hein and Mäkinen-Kiljunen, 1996	3; case report	1	1	1/1		1/1		1/1		nd		nd		1/1		0/1		1/1		1/1			1	1/1	1/1	1/1		Worker in a company manufacturing hair dyes		
*			Baur and Ludersmidt, 1983	3; case report	1	1	1/1		1/1		nd		nd		nd		1/1		0/1		nd		1/1			1	1/1	1/1	1/1		Pharmaceutical worker		
Vetch (<i>Vicia sativa</i>)	-	1	Picón, Carmona et al., 1991	3; case report	1	1	1/1		nd		nd		1/1		nd		1/1		nd		1/1		1/1			1	1/1	1/1*		Farmer. *PK			
Family Liliaceae																																	
Amaryllis (<i>Amaryllis hippastrum</i>), hybrid cultivate of hippastrum	-	1	Jansen, Visser et al., 1996	3; case report	1	1	1/1		1/1		nd		nd		1/1		1/1		1/1		1/1*		1/1**		1		1/1***		1/1***		Greenhouse worker. *PEFR during work days and off-work; **SIC+ with pollen; ***SPT+ and IgE+ with pollen, stem, petal		
Asparagus (<i>Asparagus officinalis</i>)	(*)	10	Tabar, Alvarez-Puebla et al., 2004	3+; case series	27	8 (29.6)	8/27	29.6	10/27	37	nd		nd		10/27	37	27/27	100	x*		nd		nd		8/10	80	5	3	20/27	74.1	19/27	70.4	Asparagus processing workers etc.. *Baseline FEV1 >70% of predicted in asthmatics
*			Eng, Yman et al., 1996	3; case reports	2	1 (50)	1/2*	50	1/2	50	2/2		2/2		nd		2/2		nd		nd		nd				2/2**		2/2		Housewives. **WR lightness in the throat and hoarseness" in 1/2 subjects; **prick-to-prick test with raw green and white asparagus		
*			Lopez-Rubio, Rodriguez et al., 1998	3; case report	1	1	1/1		1/1		1/1		1/1		nd		1/1		0/1		1/1		nd		1/1		1	1/1	1/1	1/1		Harvesting worker. Clinical tests with raw green asparagus; oral Ch-	
Daffodil (<i>Narcissus pseudonarcissus</i>), Trumpet narcissus	-	1	Gonçalo, Freitas et al., 1987	3; case report	1	1	1/1		1/1		1/1		nd		1/1		1/1		nd		nd		nd				0/1*		nd		Flower grower. *SPT with <i>N. p.</i> juice; patch test+ with flower and leaf of <i>N. p.</i>		
Easter Lily (<i>Lilium longiflorum</i>)	-	2	Pirilä, Kanerva et al., 1999	3; case report with follow-up	1	1	1/1		1/1		1/1		1/1		1/1		1/1		0/1		1/1		1/1				1	1/1	1/1	1/1		Floral shop worker. Also IgE+ and SPT+ with tulip	
*			Lahti, 1986	3; case report	1	1	1/1		1/1		0/1		0/1		1/1		1/1		nd		nd		nd					1/1		nd		Florist co-exposed and co-sensitized to tulips. See tulip	
*			Vidal and Polo, 1998	3; case report	1	0	0/1		1/1		1/1		nd		1/1		1/1		0/1		0/1		nd					1/1		0/1		Flower supplier co-exposed and co-sensitized to <i>Dianthus caryophyllus</i> and <i>Gypsophila paniculata</i> ; see also <i>Dianthus caryophyllus</i> and <i>Gypsophila paniculata</i>	
Garlic dust (<i>Allium sativum</i>)	(*)	10	Añibarro, Fontela et al., 1997	3+; case series	12	6 (50)	12/12	100	12/12	100	12/12	100	nd		nd		12/12	100	x*		x**		nd		7/12	58.3	5	2	7/12	58.3	5/12	41.6	Garlic workers. 6/7 SIC+ also SPT+; *baseline LFT > 80% predicted; **individual results not listed; 1/2 oral Ch induced a 35% decline in FEV1; cross-reactivity with onion
*			Seuri, Taimanen et al., 1993	3; case reports	3	2 (66.6)	3/3	100	3/3	100	3/3	100	nd		1/3	33.3	3/3	100	0/3	0	0/1	0	1/1*	100	2/2	100		2	3/3	100	3/3	100	Sausage makers and cook. *Serial PEFR for 1 week off-work and 2 weeks at work; 1/1 nasal Ch+ with garlic and with flour
*			Lybarger, Gallagher et al., 1982	3; case report	1	1	1/1		nd		nd		1/1		nd		1/1		nd		1/1		nd		1/1		1	1/1	1/1	1/1		Electrician at a spice processing plant. Oral Ch + with garlic induced a 21% decline in FEV1	
*			Falleroni, Zeiss et al., 1981	3; case report	1	1	1/1		1/1		nd		1/1		1/1		1/1		1/1		nd		1/1		1		1/1	1/1	1/1	1/1		Employee with work-aggravated asthma in a firm packaging spices, similar but milder WRS also by onion. IgE+ with onion	
Hyacinth (<i>Hyacinthus orientalis</i>)	-	-	Pirilä, Hannu et al., 1996	3; case report	1	[1]	1/1		1/1		1/1		1/1		1/1		1/1		0/1		0/1		1/1*		1/1		1	0/1		nd		Gardener. *Serial PEFR at work and off-work	
Onion (<i>Allium cepa</i>)	-	2	Valdivieso, Subiza et al., 1994	3; case reports	4	1 (25)	1/4	25	4/4	100	4/4	100	1/4	25	1/4	25	4/4	100	nd		1/2	50	nd		1/2	50	1		4/4	100	3/4	75	3 homemakers and 1 cook.

Agents	Strength of evidence per agent (three star system of RCGP)	Total no. of allergic asthma cases per agent, n	Reference	Level of evidence per study (revised SIGN grading system); study type.	Occupationally exposed subjects studied, n	Allergic asthma cases due to mentioned agent, n, prevalence (%). Cases with probable allergic asthma but specific sensitization not confirmed in parentheses [] or not indicated.	EVIDENCE (pathological results)																											Remarks					
							WORK-RELATED SYMPTOMS														LFT		NSBHR		sPFT		SIC				SPT		Spec. IgE						
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction				n/n SPT	%	n/n IgE	%							
n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%	n/n SIC	%	i	(n)	l	(n)	d							(n)														
Onion seeds, red (<i>Allium cepa</i>)			Navarro, del Pozo et al., 1995	3; case report	1	1	1/1		1/1		1/1		nd		nd		1/1		0/1		nd		nd		1/1		1		1/1		1/1		1/1		1/1		1/1		Worker packing red onion seeds. SPT+ with italian, white and violet onion seed; IgE- with onion
Sarsaparilla root dust	-	1	Vandenplas, Depelchin et al., 1996	3; case report	1	1	1/1		1/1		nd		nd		nd		1/1		1/1		nd		nd		1/1		1		1/1		1/1		1/1		1/1		Herbal tea worker		
Tulip (<i>Tulipa</i>)	-	4	Piinlä, Keskinen et al., 1994	3; case reports	2	2	2/2		2/2		1/2		1/2		2/2		2/2		1/2		1/1		1/2*		1/1		1		1/2		1/1		1/1		1/1		Gardener and florist. *Serial PEFR or FEV1 at work and at home		
*			Krüsmann and Hausen, 1987	3; case report	1	1	1/1		1/1		1/1		nd		nd		1/1		nd		1/1		1/1		1/1		1		1/1		1/1		1/1		1/1		Florist. Nasal Ch+		
*			Lahti, 1986	3; case report	1	1	1/1		1/1		0/1		0/1		1/1		1/1		nd		nd		nd		nd				1/1		nd		nd		nd		Florist co-exposed and co-sensitized to Easter Lily. See Easter Lily		
Sanyak (<i>Dioscorea batatas</i>)	-	1	Park, Kim et al., 1994	3; case report	1	1	1/1		1/1		nd		1/1		nd		1/1		nd		0/1		nd		1/1			1		1/1		1/1		1/1		1/1		Employee at herbal medicine pharmacy co-exposed and co-sensitized to Banha. See Banha	
Spice dust Garlic (<i>Allium sativum</i>) Onion (<i>Allium cepa</i>)	-	2	van der Walt, Lopata et al., 2010	3; case reports	3	2 (66.6)*	3/3	100	3/3	100	nd		nd		nd		nd		0/3**	0	1/3	33.3	2/3	66.6	nd					nd		nd		2/3	66.6	66.6	Spice mill workers. *Co-exposure to chili peppers, cayenne, soya, grain flour dust and other. Spec. IgE in the 2/3 workers for many other spices. 1 Worker was not sensitized to garlic or onion or to another spice constituent. **The sensitized workers had only mild airway obstruction		
Family Lythraceae																																							
Henna (roots of <i>Lawsonia inermis</i> L.)	-	4	Starr, Yunginger et al., 1982	3; case reports	2	1 (50)	2/2		2/2		nd		1/2		nd		2/2		0/2		nd		nd		1/2		1		2/2		2/2		2/2		2/2		2/2		Beauticians
*			Frosch and Hausen, 1986	3; case report	1	1	1/1		1/1		1/1		nd		1/1		1/1		nd		nd		nd		nd				1/1		nd		nd		nd		Hairdresser		
*			Pepys, Hutchcroft et al., 1976	3; case report	1	1	1/1		1/1		1/1		nd		nd		1/1		0/1		nd		nd		1/1		1		1/1		nd		nd		nd		nd		Hairdresser, co-exposed to persulphates. SIC+ with persulfate salts (late asthma response)
*			Majoie, Bruynzeel et al., 1996 ABSTRACT	3; case report	1	1	1/1		1/1		nd		nd		1/1		1/1		nd		nd		nd		nd				1/1		nd		nd		nd		nd		Hairdresser
Family Moraceae																																							
Weeping fig (<i>Ficus benjamina</i>)	★	10	Axelsson, Johansson et al., 1987	3+; cross-sectional	84	6 (7.1)	6/84	7.1	17/84	20.2	14/84	16.7	nd		13/84	15.5	18/84	21.4	nd		6/9		nd		6/6*	100	4		2	18/84	21.4	18/84	21.4	21.4	21.4	21.4	21.4	Plant keepers, greenhouse workers. *SIC in sensitized asthmatics; 9/9 rhinoconj. Ch+	
*			Axelsson, Skedinger et al., 1985	3; case reports	2	2	2/2		2/2		2/2		1/2		nd		2/2		nd		nd		nd		nd				2/2		2/2		2/2		2/2		2/2		Plant keepers
*			Grob, Wüthrich et al., 1998	3; case report	1	1	1/1		1/1		1/1		nd		nd		1/1		nd		nd		nd		nd				1/1		1/1		1/1		1/1		1/1		Indoor gardener. See umbrella tree
*			Diez-Gomez, Quirce et al., 1998	3; case report	1	1	1/1		1/1		1/1		nd		1/1		1/1		nd		1/1		nd		1/1		1		1/1		1/1		1/1		1/1		1/1		Plant keeper. SPT+ also to fig, kiwi, papain
Family Myricaceae																																							
Mace (<i>Myristica fragrans</i>), nutmeg	-	1	Sastre, Olmo et al., 1996	3; case report	1	1	1/1		1/1		nd		nd		nd		1/1		nd		1/1		nd		1/1		1		1/1		1/1		1/1		1/1		1/1		Butcher co-exposed to paprika and coriander. See also paprika and coriander
Family Myrsinaceae																																							
Cyclamen pollen	-	1	Bolhaar and van Ginkel, 2000	3; case reports	2	1	1/2		2/2		2/2		nd		nd		2/2		nd		nd		nd		nd				2/2		2/2		2/2		2/2		2/2		Floriculturists
Family Oleaceae																																							
Olive fruit (<i>Olea</i>)	-	1	Palomares, Alcantara et al., 2008	3; case report	1	1	1/1		1/1		nd		nd		nd		nd		0/1		1/1		1/1		nd*				1/1		1/1		1/1		1/1		1/1		Worker in an olive-oil mill. *Nasal challenge test was positive
Family Papaveraceae																																							

Agents	Strength of evidence per agent (three star system of RCGP)	Total no. of allergic asthma cases per agent, n	Reference	Level of evidence per study (revised SIGN grading system); study type.	Occupationally exposed subjects studied, n	Allergic asthma cases due to mentioned agent, n, prevalence (%). Cases with probable allergic asthma but specific sensitization not confirmed in parentheses [] or not indicated.	EVIDENCE (pathological results)																				Remarks					
							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE				
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction			n/n SPT	%	n/n IgE	%	
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%						i
Poppy (<i>Papaver somniferum</i>)	★	6	Moneo, Alday et al., 1993	3+; cross-sectional	28	6 (21.4)	6/28	21.4	nd	nd	nd	nd	nd	6/28	21.4	nd	nd	nd	nd	4/4*	4	1	1	6/28	21.4	6/28	21.4	Workers of pharmaceutical factory. 6/6 asthmatics sensitized. *SIC done only in 4 asthmatics; see also opiate				
Family Passifloraceae																																
Passion flower leaves (<i>Passiflora alata</i>), maracuja	■	1	Olavina-Bianchi, Castro et al., 1997	3; case report	1	1	1/1	1/1	1/1	1/1	1/1	1/1	nd	1/1	1/1	0/1	1/1	nd	1/1	1/1	1	1	1/1	1/1	1/1	1/1	1/1	Pharmacy worker co-exposed and co-sensitized to <i>Rhamnus purshiana</i> bark				
Family Pedalaceae																																
Sesame seeds (<i>Sesame indicum</i>)	■	1	Alday, Curiel et al., 1996	3; case report	1	1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	nd	nd	1/1	1/1	1/1	1	1	1/1	1/1	1/1	1/1	1/1	Baker with prev. diagnosis of wheat allergy. SPT+ with wheat, rye				
			Keskinen, Östman et al., 1991	3; case report	1	1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	0/1	0/1	nd	1/1	1	1	1/1	1/1	1/1	1/1	1/1	1/1	Baker				
Family Plantaginaceae																																
Senna and <i>Isapgahula husks</i>	★	4	Marks, Salome et al., 1991	2+; cross-sectional?	125	4 (3.2)	10/125	8.0	+	+	nd	+	nd	4/119	3.4	9/112**	8	nd	nd	nd	nd	nd	21/118**	17.8	nd	nd	Pharmaceutical workers. *21/115 WR nose, eye, and skin symptoms; **NSBHR in LFT; ***SPT+ with ispaghula and/or senna; 9/118 SPT+ with ispaghula, 18/118 SPT+ with senna; 4 OA, defined as at least one WR respiratory symptom, SPT+ to at least one occupational allergen, and either NSBHR+ or BD+ or physician diagnosed asthma					
Psyllium (<i>Plantago ovata</i> , <i>Plantago psyllium</i> or <i>Plantago indica</i>)	★★	31	Malo, Cartier et al., 1990a	2+; cross-sectional	197	8 (4.1)	24/197	12.2	65/197	33	nd	nd	9/193	4.7	nd	2/10*	20	20/70*	28.6	nd	8/10**	80	3	5	10/191	5.2	24/166	14.5	Health personnel of 4 hospitals. 4 preceding cases of OA intricated in cross-sectional study of 193 subjects; *LFT and BHR only in symptomatics or sensitized; individual LFT parameter given only in 10 individuals; **SIC in symptomatic, sensitized, and BHR+			
			Bardy, Malo et al., 1987	2+; cross-sectional	130	5 (3.9)	39/130	30	39/108	36	25/108	23.2	nd	nd	3/125	2.4	12/35*	3/33**	5/18***	5	5	23/120	19.2	31/118	26.3	26.3	Workers of a pharmaceutical company surveyed before and during production period. *NSBHR in asthmatics only; **PEFR for 2 weeks in asthmatics only; ***SIC in SPT+, NSBHR+ and PFT+; sign. association between asthmatic symptoms and SPT+; all 5 SIC+ also SPT+					
			McConnochie, Edwards et al., 1990	2+; cross-sectional	92	4 (4.3)**	18/92	19.6	27/92	29.3	24/92	26.1	nd	1/92	1.1	48/92	52.2	nd	nd	nd	nd	5/92*	5.4	9/92*	9.8	9.8	Workers of a pharmaceutical factory. *11/92 sensitized. **4/18 asthmatics SPT+, 4/18 asthmatics IgE+, integral not given					
			Kirby, Bardy et al., 1986	3+; cross-sectional	188	*	*	*	*	nd	nd	nd	nd	66/188	35.1	nd	nd	nd	nd	nd	nd	39/188	20.7	22/188	11.7	11.7	Workers in 2 plants producing psyllium hydrophilic mucilloid. *66 had asthma or rhinoconjunctivitis, individual figures not given. (32/66 symptomatics were sensitized)					
			Göransson and Michaelson, 1979	3+; cross-sectional	64	[6 (9.4)]	6/64	9.4	26/64	40.6	14/64	21.9	nd	nd	27/64	42.2	nd	nd	nd	**	nd	28/64***	43.8	nd	nd	nd	Employees at a pharmaceutical factory. ***IC, *18/27 symptomatics were sensitized, sensitized asthmatics not listed. **18/35 either conj., nasal or inhalation Ch+;					
			Nelson, 1987	3+; survey	743	[25 (3.5)]	25/717	3.5	67/723	9.3	+	nd	6/665	0.9	136/743	18.3	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Health care workers				
			Machado, Olsson et al., 1983	3+; case series	15	5 (33.3)	5/15	33.3	15/15	100	nd	nd	15/15	100	15/15	100	nd	nd	nd	5/15	33.3	5	5	15/15	100	15/15	100	Symptomatic sensitized nurses and pharmaceutical workers				
			Cartier, Malo et al., 1987	3; case series	5	5	5/5	5/5	5/5	5/5	nd	nd	5/5	1/5	4/5	4/5	nd	nd	5/5	2	3	4/4	5/5	5/5	5/5	5/5	Nurses. 4/5 SIC+ and 1/5 had to be intubated, FEV1 could not be measured					
			Busse and Schoenwetter, 1975	3; case reports	3	2 (66.6)	3/3	2/3	66.6	1/3	33.3	1/3	33.3	3/3	100	nd	nd	nd	2/3	66.6	2	3/3*	100	nd	nd	nd	Workers of pharmaceutical firm. *3/3 IC+ with plantain and with psyllium husk					
			Vaswani, Hamilton et al., 1996	3; case report	1	1	1/1	1/1	nd	nd	nd	nd	1/1	nd	nd	nd	nd	nd	nd	nd	1/1	1/1	1/1	1/1	1/1	1/1	1/1	Nurse with an episode of anaphylaxis after Psyllium ingestion				
			Gauss, Alarie et al., 1985	3; case report	1	1	1/1	nd	1/1	nd	1/1	1/1	1/1	1/1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	1/1	1/1	1/1	Pharmaceutical worker				
Family Plumbaginaceae																																
Stalice (<i>Limonium tataricum</i>), sea lavender	■	1	Ueda, Tochigi et al., 1992	3; case reports	3	0	0/3	3/3	3/3	3/3	nd	nd	3/3	nd	nd	nd	nd	nd	nd	nd	nd	nd	3/3*	3/3	3/3	3/3	3/3	Greenhouse workers. * I.C.; 3/3 + nasal Ch; 3/3+ conj. Ch				

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							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE				
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction			n/n SPT	%	n/n IgE	%	
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%						i
			Quirce, García-Figueroa et al., 1993	3; case report	1	1	1/1		1/1		1/1		1/1		1/1		1/1		1/1*		1/1		1		1/1		1/1		Floral industry worker. *Serial PEFR at work and at home for 4 weeks			
Family Poaceae=Gramineae																																
Esparto grass (<i>Stipa tenacissima</i>)	-	1	Ruiz-Hornillos, De Barrio Fernández et al., 2007 ABSTRACT	3; case report	1	1	1/1		nd		nd		nd		nd		nd		1/1		nd				1/1		1/1		Building industry worker.			
Grass juice (<i>Lolium perenne</i>)	-	1	Subiza, Subiza et al., 1995	3; case report	1	1	1/1		1/1		nd		1/1		nd		1/1		nd		1/1		1		1/1		1/1		Gardener			
Rice (<i>Oryza sativa</i>)	-	3	Kim, Choi et al., 2010	3; case reports	3	3*	3/3		nd		nd		nd		nd		3/3		3/3		3/3		3		3/3		3/3		Rice millers or farmer SPT+ for common allergens and rice extract in 2/3. One case had SPT+ only to rice extract			
Family Rosaceae																																
Peach (<i>Prunus persica</i>)	-	2	Moya, Hernández et al., 2002	3; case report	1	1	1/1		1/1		nd		1/1		nd		1/1		x		nd		1/1		1		1/1		1/1	Fruit factory worker. WRS also with apricot; SPT+ and IgE+ with apricot		
			García, Lombardero et al., 2004	3; case report	1	1	1/1		1/1		1/1		1/1		nd		1/1		1/1		nd		1		1/1		1/1		Fruit grower. Clinical tests with peach leaves			
Raspberry (<i>Rubus idaeus</i>)	-	1	Sherson, Andersen et al., 2003	3; case report	1	1	1/1		1/1		1/1		nd		1/1		0/1		0/1		1/1*		nd		1/1		1/1		Chewing gum factory worker. *PEFR for 8 weeks at work; HR-			
Rose (<i>Rosa rugosa</i>)	*	20	Demir, Karakaya et al., 2002	2-; cross-sectional	290	18 (6.2)	69/290*	23.8	38/290*	13.1	25/290*	8.6	23/290*	7.9	26/290*	9.0	nd		nd		nd		nd		12/70	17.1	8/41	19.5	Rose cultivators. *New-onset and exacerbated symptoms, 18/290 (6.2%) new-onset asthma			
Rose hips (<i>Rosa rugosa</i>)			Kwaselow, Rowe et al., 1990	3+; case series	13	2 (15.4)	9/13	69.2	5/13	38.5	nd		nd		2/9	22.2	13/13	100	nd		nd		2/4*	50	2	7/13	53.8	7/13	53.8	13 symptomatic employees of vitamin manufact. plant, 1 with work-exacerbated asthma. *SIC in sensitized asthmatics		
Rose (<i>Rosa domescena</i>)	-	-	Akkaya, Örnek et al., 2004	3+; cross-sectional	52	[1 (1.9)]	1/52	1.9	2/52	3.8	1/52	1.9	2/52	3.8	nd		nd		*		42/52	80.7	nd		nd		28/52	53.8	nd	Workers in a rose extracting plant and 30 controls. *No significant differences in FEV1, FVC, and FEV1/FVC between controls and workers. Not indicated if asthma case is sensitized.		
Strawberry (<i>Fragaria ananassa</i>)	-	1	Patiwael, Vullings et al., 2010	3+; survey	75	1 (1.3)	4.2		30.7		23.3		nd		nd		29/75	38.7	0/3*		0/3*		nd		nd		3/3*	2/3**	Strawberry greenhouse workers, response rate to questionnaire: 50.3%. *3 workers with work-related symptoms were investigated in detail. 1 with asthma and rhinoconjunctivitis, the others with rhinoconjunctivitis and skin symptoms. LFT and NSBHR were not indicated in detail but adjudged as normal. Nasal provocation test was positive in 2/3 **Spec.IgE was not present in the worker with asthma			
Family Rubiaceae																																
Coffee, raw (<i>Coffea arabica</i>)	*[*]	51	Jones, Hughes et al., 1982	2-; cross-sectional	372	7 (1.9)	7/372*	1.9	nd		nd		nd		nd		nd		**		nd		***		nd		93/362**	25.7	39/331	11.8	Green coffee processing plant workers. *New-onset asthma; **sign. association between length of exposure and FEV1 decline as compared to those with roasted coffee exposure, also IgE+ subjects had sign. declines of FEV1, FEV1/FVC and FEF25-75; ***Pre- and postshift PFT. The mean change in FEV1 for all 66 tested subjects was -0.024 L; ****SPT with collector dust	
Coffee, raw			Thomas, Tngg et al., 1991	2-; cross-sectional	150	9 (6.0)			nd		nd		*		nd		19/150*	12.7	nd		45/150	30	nd		nd		22/150	14.7	28/150	18.6	Coffee workers. *WRS (wheeze, cough, or dyspnoea) sign. associated with IgE+ (castor bean) and duration of employment; 9/19 symptomatics IgE+ with castor bean	
Green coffee																																
Castor beans (<i>Ricinus communis</i>)																																
Coffee, raw (<i>Coffea arabica</i>)			Romano, Sulotto et al., 1995	3+; cross-sectional	211	[34]	34/211	16.1	55/211	26.1	55/211	26.1	nd		nd		56/211	26.5	nd		nd		nd		nd		nd		nd		Coffee workers. Sensitized asthmatics not listed	
Green coffee																																
Castor beans (<i>Ricinus communis</i>)																																
Green coffee beans																																
Castor beans (<i>Ricinus communis</i>)			????	3+; cross-sectional	129		19/129	14.7	40/129	31	31/129	24	nd		21/129	16.3	56/129	43.4	nd		nd		nd		nd		24/129	18.6	nd		Coffee workers. 28/129 (21.7%) were sensitized to occupational allergens; sensitized asthmatics not listed	

Agents	Strength of evidence per agent (three star system of RCGP)	Total no. of allergic asthma cases per agent, n	Reference	Level of evidence per study (revised SIGN grading system); study type.	Occupationally exposed subjects studied, n	Allergic asthma cases due to mentioned agent, n, prevalence (%). Cases with probable allergic asthma but specific sensitization not confirmed in parentheses [] or not indicated.	EVIDENCE (pathological results)																												Remarks	
							WORK-RELATED SYMPTOMS														LFT		NSBHR		sPFT		SIC				SPT		Spec. IgE			
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction				n/n SPT	%	n/n IgE	%				
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%	i	n					l	(n)		d
Coffee, raw (<i>Coffea arabica</i>)			Larese, Fiorito et al., 1998	2-; cross-sectional	31	1 (3.2)	2/31	6.5	4/31	12.9	2/31	6.5	nd	nd	6/31	19.4	*	nd	nd	nd	nd	nd	nd	8/31	25.8	3/8**							31 green coffee workers. *No sign. difference in LFT between exposed and non-exposed; **IgE done in symptomatic or SPT+; 1/2 asthmatics SPT+ and IgE+			
Coffee, raw (<i>Coffea arabica</i>)			Zuškin, Valić et al., 1981	2-; cross-sectional	45	2 (4.4)	1/37	2.7	nd	nd	nd	nd	nd	1/31	2.7	*	nd	nd	x**	nd	nd	nd	1/37	2.7	1/1**	nd							37 roasted coffee workers			
Green coffee																							5/45***	12									Coffee workers. *17/45 rhinitis or conj.; **sign. mean decrease in maximum expiratory flow (MEF) rate at 50% and 25% of vital capacity; ***IC; 2/4 asthmatics had SPT+			
Roasted coffee																							4/45***	8.9												
Coffee bag dust																							18/45***	45												
Green coffee beans																							18/25		12/25									Symptomatic coffee workers. (20/25 were sensitized to occupational allergens); sensitized asthmatics not listed		
Castor beans (<i>Ricinus communis</i>)																								18/25												
Roasted coffee																									7/25											
Coffee, raw (<i>Coffea arabica</i>)			Zuskin, Valic et al., 1979	3+; survey	72	2 (2.7)	34/72	47.2	45/72	62.5	28/72	38.9	30/72	41.7	nd	nd	+	nd	+	+	+	+	nd	nd	nd	nd								72 roasted coffee processors. *2 subjects with asthma had LFT+ and PFT+; **sign. mean acute reductions in FEF50		
					31	1 (3.2)	13/31	41.9	3/31	9.7	8/31	25.8	12/31	38.7	nd	nd	+	nd	+	+	+	+	nd	nd	nd	nd									31 green coffee processors. *1 subject with asthma had LFT+ and PFT+; **sign. mean acute reductions in FEF50	
			Osterman, Johansson et al., 1985	3+; case series	22	8 (36.4)	11/22	50	20/22	90.9	5/22	22.7	nd	3/22	13.6	22/22	100	nd	14/22	63.6	x*	8/22**	36.4	6	2	18/22	81.8	11/22	50%						Coffee roastery workers. *Serial PEFR at work and off-work for 1 week; PEFR in subjects with SPT+ sign.declined; **SIC done with green coffee beans, all 8 SIC+ were sensitized asthmatics	
			Zuskin, Kanceljak et al., 1985	3+; case series	9	4 (44.4)	6/9	66.6	9/9	100	9/9	100	9/9	100	nd	9/9	100	4/9	44.4	nd	nd	4/9	44.4	4		6/9*	66.6	nd								Coffee workers. *IC; all 4 SIC+ were SPT+
Roasted coffee																							1/9													
			Karr, Lehrer et al., 1978	3+; case series	8	6 (75)	6/8	75	6/8	75	6/8	75	nd	6/8	75	6/8	75	3/8	37.5	nd	nd	2/2	100	2		6/8*	75	6/8	75							Coffee workers. *IC; both SIC+ asthmatics were sensitized
Coffee green			Karr 1979	3+; case series	8	6 (75)	6/8	75	6/8	75	6/8	75	nd	6/8	75	6/8	75	nd	nd	nd	2/2	100	2		6/8	75	6/8	75								8 symptomatic coffee workers underwent bronchoprovocative studies; *IC; both SIC+ subjects were sensitized
Coffee (raw)			Wallenstein and Schöneich, 1983	3; case reports	2	1 (50)	2/2		2/2		0/2		0/2		2/2		0/2		1/2		nd	1/1	1		2/2		2/2								Coffee workers. 1/1 nasal Ch+	
			Lemiere, Malo et al., 1996	3; case report	1	1	1/1		1/1		1/1		nd		1/1		1/1		nd		1/1*				1/1		1/1								Coffee production worker. *Serial PEFR at work and off work	
			Müsken, Bergmann et al., 1992	3; case report	1	1	1/1		nd		nd		nd		1/1		1/1		1/1		nd		1/1		1/1		1/1								Coffee factory worker	
			Herrmann, Hausen et al., 1991 ABSTRACT	3; case report	1	1	1/1		nd		nd		1/1		1/1		nd		nd		nd		1/1		1/1		1/1								Locksmith in a coffee processing plant	
Ipecacuanha (<i>Cephaelis ipecacuanha</i> and/or <i>Cephaelis acuminata</i>)			Luczynska, Marshall et al., 1984	3+; cross-sectional	42	-*	-	-	-	-	nd		nd	20/42*	47.6	nd		nd	nd	nd	nd	nd				13/39	33.3	14/32**	43.8						Workers packing Ipecacuanha tablets. *WR-allergic symptoms (rhin., conj. and chest tightness), not individually listed; 12/18 IgE+ and 10/19 SPT+ subjects had WRS	
Family Solanaceae																																				
Eggplant pollen (<i>Solanum melongena</i>)		1	Gil, Hogendijk et al., 2002	3; case report	1	1	1/1		1/1		1/1		1/1	nd	1/1		1/1		nd		nd				1/1		nd								Agricultural worker. Conj. Ch+ with pollen	
Paprika (<i>Capsicum annuum</i>)		55	Patiwael, Jong et al., 2009	2-; cross sectional with follow-up	322	10 (3.1)*	19/231*	9	27/143	19	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	16/184	9	nd						Greenhouse employees. Follow-up study of the cross-sectional study of Groenewoud, de Jong et al., 2002. Indicated are new cases during 8-year follow-up. *Of the 19 new asthma cases, 10 were newly sensitized.		
			Groenewoud, de Jong et al., 2002	2-; cross-sectional	472	42 (8.9)	63/472	13.3	233/472	49.4	143/472	30.3	nd	42/472	8.9	254/472	53.8	nd	nd	x*	nd	nd	nd	nd	nd	167/472	35.4	88/472	18.6						Greenhouse employees. Clinical test with pollen, stamen, juice, leaf and/or stem; *PEFR 2/day for 2 weeks in 436 subjects showed sign. lower PEFMEAN in those with asthmatic symptoms; 42/472 sensitized asthmatics	
			Toorenenbergen van and Dieges, 1984	3; case report	1	1	1/1		1/1		1/1		nd	nd	1/1		nd		nd		nd				1/1		1/1								Greenhouse worker. Clinical tests with flower, leaf and stem	
			Sastre, Olmo et al., 1996	3; case report	1	1	1/1		1/1		nd		nd	nd	1/1		nd		1/1		nd		1/1		1/1		1/1								Butcher co-exposed to mace and coriander. See mace and coriander	

Agents	Strength of evidence per agent (three star system of RCGP)	Total no. of allergic asthma cases per agent, n	Reference	Level of evidence per study (revised SIGN grading system); study type.	Occupationally exposed subjects studied, n	Allergic asthma cases due to mentioned agent, n, prevalence (%). Cases with probable allergic asthma but specific sensitization not confirmed in parentheses [] or not indicated.	EVIDENCE (pathological results)																				Remarks				
							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE			
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	n/n NSBHR	n/n PFT	n/n SIC	Reaction			n/n SPT		n/n IgE			
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%					% i	% n	% l				% d	% n	% SPT
Paprika (<i>Capsicum tetragonum</i>)			Toorenenbergen van and Dieges, 1985	3; case report	1	1	1/1		1/1		nd		nd		nd	1/1		nd		nd		nd		nd		1/1		1/1		Employee in the spice factory.	
Potato (<i>Solanum tuberosum</i>)	-	2	Zack, Doekes et al., 1996	3+; cross-sectional	131	[5 (3.8)]	5/131	3.8	nd		nd		9/131	6.9	nd	21/131	16.0	nd		nd		nd		nd		nd		0/117		Workers of 4 potato processing plants. IgG 111/117 (95%)	
			Quirce, Gómez et al., 1989	3; case reports	2	2	2/2		2/2		2/2		1/2		1/2	2/2		0/2		2/2		2/2		2		2/2		2/2		Housewives	
Tobacco leaf dust (<i>Nicotiana tabacum</i>)	*[*]	2	Mustajbegovic, Zuskin et al., 2003	2+; cross-sectional	121	[6 (5)]*	6/121	5	nd		nd		35/121	29	nd	nd		**		nd		***		nd		nd		nd		Tobacco workers. 81% response rate. sensitization indicated. OA diagnosed by physical examination and spirometric measurements during exposure to dust at or following work. **FEV1, FEF50 and FEF25 were significantly decreased. 3% had FEV1 < 70% of predicted values. ***Significant decrease in FEV1, FEF50 and FEF25 in 38 workers studied.	
Tobacco leaf dust (<i>Nicotiana tabacum</i>)			Vaic, Beritic et al., 1976	2+; cross-sectional	318	[32 (10.1)]	32/318	10.1	nd		nd		nd		nd	nd		*		nd		**		nd		nd		nd		Female tobacco workers in 3 cigarette factories. *No sign. impairment of FEV1 and FVC; **sign. acute decrease in FEV1 and FVC during work-shift in exposed (117 tested); sign. higher prevalence of chronic asthmatic symptoms among exposed	
			Viegi, Paggiaro et al., 1986	3+; cross-sectional	223	[10 (4.5)]	10/223	4.5	20/223	9.0	nd		nd		nd	nd		*		nd		nd		nd		14/182**	7.7	nd		Workers at a cigar and cigarette factory. *All LFTs in older women. FEF75-85 in younger women and in men lower than reference; **SPT in men and younger women only; sensitized asthmatics not listed.	
			Mukhtar, Rao et al., 1991	3+; survey	195	-	nd		nd		nd		nd		nd	nd		*		nd		nd		nd		nd		nd		Workers of a tobacco factory. *Sign. decrease in all parameters of ventilatory capacity in exposed as compared to unexposed controls	
Tobacco (raw)			Uitti, Nordman et al., 1998	2+; cross-sectional	106	-*	-		-		-		nd		5/106	4.7	16/106**		nd		nd		nd		nd		0/106		nd		Cigar factory workers. *No sign. difference in WRS between exposed and controls. individual data not listed; **sign. decreased FEV1, FVC and MEF25 in exposed
Tobacco			Kjaergaard, Pedersen et al., 1989	2+; cross-sectional	75	[1 (1.3)]	1/75*	1.3	nd		nd		nd		nd	nd		**		12/71**	17	**		nd		nd		18/75**		Cheroot factory workers. *Physician diagnosed asthma or hayfever, not clear whether WR; **Not sign. different in exposed	
			Lander and Gravesen, 1988	2+; cross-sectional	16	[8 (50)]	11/16	68.8	nd		1/1		1/1		nd	nd		x**		nd		8/16*		nd		nd		nd		Workers of tobacco plant. *PEF before and after work for at least 1 week; sign. greater diurnal change; **sign. lower FVC and FEV1	
			Gleich, Welsh et al., 1980	3; case report	1	1	1/1		1/1		nd		1/1		nd	1/1		nd		nd		nd		1/1		1		1/1		Tobacco manufacturer	
			Baur, 1993	3; case report	1	1	1/1		1/1		1/1		nd		nd	1/1		1/1		nd		nd		nd		1/1		1/1		Worker in a tobacco plant. Nasal Ch+	
Family Sterculiaceae																															
Cacao beans (<i>Theobroma cacao</i>)	-	1	Perfetti, Lehrer et al., 1997	3; case report	1	1	1/1		1/1		nd		1/1		nd	1/1		0/1		1/1		1/1*		1/1**		1		1/1		Confectionery worker. *Serial PEFR and FEV1; **SIC with cocoa powder	
Family Theaceae																															
Tea dust (Camomile, dog-rose, gruzyan tea, Indian tea, sage)	*[*]	8	Zuskin and Skuric, 1984	2+; cross-sectional	100	[3 (3)]	45/100*	45	-		32/100*	32	48/100*	48	nd	nd		x		nd		57/100**	57	nd		nd		nd		Employees processing different types of tea. *Acute WRS; **sign. mean acute decline in FEF50 and FEF75 across-shift; ***acute reductions in maximal expiratory flow rate (MEF) across-shift, not clear whether significant; 3 employees had WR asthma and PFT+	
Camomile					26	1 (3.9)	13/26	50	11/26	42.3	12/26	46.2	13/26	50	nd			2/26	8.0			x									
Dog-rose					10	1 (10)	4/10	40	4/10	40	4/10	40	4/10	40	nd			1/10	10			x**									
Gruzyan					28	1 (3.6)	14/28	50	12/28	42.9	13/28	46.4	14/28	50	nd			3/28	11			x**									
Indian					16		5/16	31.5	1/16	6.3	3/16	18.8	4/16	25	nd			0/16	0			x**									
Sage					20		9/20	45	10/20	50	0/20	0	13/20	65	nd			1/20	5			x**									
Tea dust (Camomile, dog-rose, gruzyan tea, Indian tea, sage)			Zuskin, Kanceljak et al., 1985	2+; cross-sectional	26	3 (11.5)	10/26	38.5	8/26	30.8	3/26	11.5	nd	nd	nd			x*		nd		x**		4/6		4		15/26		26 volunteers from the previous cross-sectional study above. *Sign. lower pre-shift FEF50 and FEF75; **sign. across-shift decline in FEF50 and FEF75; 1 SIC+ and SPT+ with dog rose, 1 SIC+ and SPT- with gruzyan tea, 2 SIC+ and SPT- with sage; 1 asthmatic was SPT+ with sage and gruzyan	
Dog rose						1 (3.9)																	1/6		1		3/26	10			
Gruzyan						1 (3.9)																	1/6		1		10/26	40			
Mentha																										9/26	35				
Sage						1 (3.9)																	2/6		2		12/26	45			
Tea dust (<i>Camellia sinensis</i>)			Jayawardana and Udupihille, 1997	2+; cross-sectional	53	[1 (1.9)]	1/53	1.9	3/53	5.7	nd		nd		nd			+		nd		nd		nd		nd		nd		Tea workers. *Sign. decreased FEV1, FEF25-75	
			Hill and Waldron, 1996	3+; cross-sectional	249	0	+		+		nd		+		nd			+		nd		+		nd		nd		nd		Group of subjects in a tea packaging plant. *Higher prevalence of rhinitis, cough and chest tightness in exposed; **Mean PEF was higher at the non-working days, measured for 12 days. No evidence that tea fluff contains materials which may induce asthma.	

Agents	Strength of evidence per agent (three star system of RCGP)	Total no. of allergic asthma cases per agent, n	Reference	Level of evidence per study (revised SIGN grading system); study type.	Occupationally exposed subjects studied, n	Allergic asthma cases due to mentioned agent, n, prevalence (%). Cases with probable allergic asthma but specific sensitization not confirmed in parentheses [] or not indicated.	EVIDENCE (pathological results)																						Remarks				
							WORK-RELATED SYMPTOMS											LFT		NSBHR		sPFT		SIC				SPT		Spec. IgE			
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction					n/n SPT	%	n/n IgE	%
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%	i	n					
			Uragoda, 1980	3+; survey	125	[3 (2.4)]	3/125	2.4	nd	nd	nd	nd	nd	nd*	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Tea workers. *31 had chronic bronchitis, 8 had asthma, 3/8 had WR asthma			
			Cartier and Malo, 1990	3; case reports	3	[3]	3/3		2/3	nd	3/3	nd	3/3	0/3	3/3	2/3*	2/3	66.7	2		0/3		0/2		0/2		Teapackers. *Serial PEF at work and off-work for 3 weeks						
	green		Shirai, Sato et al., 1994	3; case reports	3	3	3/3		3/3	nd	3/3	nd	3/3	nd	3/3	nd	3/3		3		3/3*		3/3**			Employees in green tea factories. *IC, IC and SIC with epigallocatechin gallate; 3/3 IC+ and 1/1 SIC+ with oolong and black tea; 1/3 oral Ch+; **PK							
			Lewis and Morgan, 1989	3; case report	1	[1]	1/1		nd	nd	nd	nd	1/1	1/1	1/1	nd	1/1			1	nd		nd			Worker at a company processing tea							
			Senff, Hausen et al., 1989	3; case report	1	1	1/1		1/1	nd	nd	nd	1/1	nd	nd	nd	nd					1/1*		1/1		Tee trader. *Rub test							
			Uragoda, 1970	3; case report	1	1	1/1		1/1	nd	nd	nd	1/1	nd	nd	nd	1/1		1		1/1		nd			Tea maker. Clinical test done with tea fluff containing <i>Aspergillus</i> , <i>Penicillium</i> and <i>Chromobacteria</i>							
			Roberts and Thomson, 1988	3; case report	1	[1]	1/1		1/1	nd	1/1	nd	1/1	0/1	nd	1/1*	1/1		1		0/1		nd			Tea-packer. *Serial PEFR 5 days at work and 9 days off-work							
Other Plant Families																																	
Dried fruits and teas		-	Zuskin, Kanceljak et al., 1996	3+; survey	54	[18 (33.3)]	18/54	33.3	7/54	12.9	nd	18/54	33.3	nd	nd	+									39/50***	78	nd	Workers processing dried fruit and teas. *Mean pre-shift FEF25 sign. lower than predicted; **sign. across-shift reductions of ventilatory capacity; ***SPT+ with at least one occupational allergen; sensitized asthmatics not listed					
Apple																									2/50	4							
Lemon																									5/50	10							
Orange																									7/50	14							
Pineapple																									9/50	18							
Peach																									3/50	6							
Chamomile																									2/50	4							
Dog rose																									10/50	20							
Sage																									30/50	60							
Flowers		[*]	Jong de, Vermeulen et al., 1998	3+; cross-sectional	14	10 (71.4)	10/14	71.4	14/14	100	14/14	100	nd	5/14	35.7	14/14	100	nd	nd	nd	nd								Flower industry workers				
Ageratum																									7/14	50							
Asteraceae																									6/14	42.9							
Asclepias																									4/14	28.6							
Aster																									2/14	14.3							
Chrysanthemum																									8/14	57.1	10/11	90.9					
Dianthus																									5/14	35.7							
Euphorbia																									6/13	46.1							
Eustoma																									7/14	50							
Freesia																									6/14	42.9							
Gerbera																									4/13	30.8							
Helianthus																									5/14	35.7							
Limonium																									1/14	7.1							
Matricaria																									12/14	85.7							
Narcissus																									5/14	35.7							
Pelargonium																									4/14	28.6							
Saintpaulia																									2/14	14.3							
Solidago																									12/14	85.7	11/11						
Flowers			Goldberg, Confino Cohen et al., 1998	3+; cross-sectional	75	*	*	*	*	nd	nd	nd	35/75	45.3	nd	nd	nd	nd	nd	nd					39/75	52	nd	Rural flower growers. * Individual symptoms not listed, 29 of the 35 symptomatics had asthma and/or rhinitis. SPT results for individual flowers in sensitized only. 11/29 growers with asthma and/or rhinitis were SPT+.					
Asteraceae																									36/39	92							
Gentianaceae																									7/39	18							
Liliaceae																									7/39	18							
Ranunculaceae																									5/39	13							
Scrophulariaceae																									9/39	23							
Herbal tea (containing chaparral, red clover, mint etc.)		-	Blanc, Trainor et al., 1986	3; case report	1	[1]	1/1		nd	1/1	1/1	nd	1/1	1/1	1/1	nd	nd	nd	1/1	1				nd	nd			Worker processing herbal tea					
Herbal tea		-	Castellan, Boehlecke et al., 1981	2-; survey	206	[1 (0.5)]	21/206	10	nd	nd	nd	nd	nd	nd	+	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd		Workers of a herbal tea processing plant. *Mean FEV1/FVC ratios were >80% for all exposure categories; **no sign. changes in FEV1 between exposure groups; 1 subjects had symptoms of OA, he was also PFT+ and LFT+					
Herbs, aromatic (thyme, rosemary, bay leaf, garlic)		-	Lemière, Cartier et al., 1996	3; case report	1	1	1/1		1/1	nd	1/1	nd	1/1	0/1	1/1	1/1	1/1	1/1	1					1/1	1/1		Butcher. SIC+ and SPT+ with garlic, rosemary, thyme, bayleaf. IgE+ with garlic, bay leaf						
Lime flower		-	Rudzki, Rapiejko et al., 2003	3; case report	1	1	1/1		1/1	1/1	1/1	nd	1/1	1/1	nd	nd	nd	nd	nd					1/1	nd		Cosmetician co-exposed and co-sensitized to camomile. *Nasal Ch+						
Natural fibers		-	Muttari, Veneskoski et al., 1978	3; case series	136	4 (2.9)	45/83*	+	nd	nd	nd	nd	136/136	100	nd	41/101	40.6	nd	20/108**	18.5				4/104	nd		Textile workers with suspected allergy for fiber. *WRS in SIC-; **type of reaction not listed; 4/20 SIC+ were SPT+; also 16/79 SIC+ with synthetic fibers, of whom 4/16 SIC+ were SPT+						
Cotton fiber																									7/20								
Cotton flock																									5/25								
Flax																									2/13								
Jute																									1/5								
Wool																									6/32								

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							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC					SPT		Spec. IgE				
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction				n/n SPT	%	n/n IgE	%		
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%		i					n	l
Pectin (carbohydrate of plant cells)	■	2	Cohen, Forse et al., 1993	3; case report	1	1	1/1		1/1		nd		1/1		nd		1/1		0/1		1/1		1/1*		nd				1/1		nd		Worker manufacturing jam. *Serial PEF at work and at home for 5 weeks	
			Kraut, Peng et al., 1992	3; case report	1	1	1/1		1/1		1/1		nd		nd		1/1		1/1		1/1		nd		1/1		1		1/1		0/1		Candy maker. Positiv pectin specific IgG.	
Sisal	■	2	Zuskin, Kanceljak et al., 1994	2-; cross-sectional	50	[2 (4.0)]	2/50	4.0	nd		nd		nd		nd		nd		x*		x**		nd						nd		nd		Sisal workers. *Individual results not listed; **sign. across shift reduction of FVC and FEV1, reduction larger at follow-up; ***both SPT+ asthmatics	
				Follow-up study	20	2 (10)	7/20	35	4/20	20	12/20	60	12/20	60	nd		nd		x*		x**		nd					2/20***	10	nd				
Spices: Coriander (<i>Coriandrum sativum</i>) and other spices: mace (<i>Myristica fragrans</i>), ginger (<i>Zingiber officinale</i>), paprika (<i>Capsicum tetragonum</i>), curry.	■	1	Toorenenbergen van and Dieges, 1985	3; case report	1	1	1/1		1/1		nd		nd		nd		1/1		nd		nd		nd					1/1		1/1		Employee in the spice factory. SPT+ with curry, coriander, mace. IgE+ with curry, coriander, mace, ginger, paprika; no cross-reaction between spices detected		
Tragacanth gum	■	1	Bircher and Wütrich, 1992	3; case report	1	1	1/1		1/1		1/1		nd		nd		1/1		nd		nd		nd					1/1*		0/1		Ice cream production worker, co-exposed and co-sensitized to St. John's bread seed. *Scratch test; see St. John's bread seed		
Voacanga africana seed dust, APOCYNACEAE family	■	1	Hinojosa, Moneo et al., 1987	3; case report	1	1	1/1		1/1		1/1		1/1		nd		1/1		0/1		nd		nd		1/1		1		1/1		1/1		Housewife indirect exposed through her husbands clothing, a chemist in a pharmaceut. plant	
Natural thickening products	■	3	Steger, Radon et al., 2000	2-; survey	62	3 (4.8)	6/62	9.7	+	+	8/62	12.7	+	+	34/62	54.8	x**		nd		nd		nd										Staff of a plant producing natural thickeners. *Individual results not listed; **FVC sign. decreased in highly exposed workers; 10/62 (9.7%) sensitized to at least 1 WR allergen, 3/10 were asthmatics	
Cassia spp., Leguminosae family	■																																	
Guar (<i>Cyamopsis tetragonoloba</i>);	■																																	
Tamanind tree (<i>Tamarindus indica</i>)	■																																	
Storage mites (<i>A. siro</i> , <i>T. putrescentia</i> , <i>L. destructor</i>)	■																																	
Wood dust	■																																	
Maple (hardwood) and pine (softwood)	■	-	Whitehead, Ashikaga et al., 1981 ABSTRACT	3+; survey	1157	-													+															Woodworkers. *Odds ratio for reduced pulmonary function (FEV1/FVC) in high exposed was 3.12 for maple and 2.61 for pine
East African teak trees (<i>Chlorophora excelsa</i>), mahogany (<i>Khaya nyasiga</i>), blood wood (<i>Pterocarpus angolensis</i>), East African camphor (<i>Ocotea usambarensis</i>), East African Alzelia Burl (<i>Alzelia quanzensis</i>), "mitanga" (<i>Albizia spp.</i>) African pencil cedar (<i>Juniperus procera</i>), African blackwood (<i>Dalbergia melanoxylon</i>), "kawilia" (<i>Grevillea robusta</i>), podo (<i>Podocarpus gracilior</i>), cypress (<i>Taxodium distichum</i>), pine (<i>Pinus patula</i>)	■	-	Rongo, Besselink et al., 2002	3+; cross-sectional	546	[106 (19.4)]	106/546*	19.4	50/546*	9.2	17/546*	3.1	151/546*	27.7	3/546*	0.5	nd		nd		nd		nd		nd									Workers in small-scale wood industries. *Sign. increased in exposed subjects
Wood dust	■	-	Paggiaro, Vellutini et al., 1986 ABSTRACT		239	-			nd		nd		*		nd		*		**		nd		nd		nd									Furniture plant workers. *Sign. higher prevalence of cough and wheeze in smokers than in non smokers and in non smoker exposed than in the control group. **Sign. lower values in smokers; after adjusting for age and smoking lower FEV1 in subjects with more working years
Wood (Eucalypt, radiata pine, meranti, sugar pine, tasmanian oak, american oak, jarrah, tasmanian blackwood, wester red cedar)	■	-	Mandyk, Alwis et al., 1999	2-; cross-sectional	197	[21 (10.8)]	21/195	10.8	83/195	42.6	nd		119/195	61.0	nd		nd		1/168		nd		**/168		nd									Woodworkers. *Pos. correlation with number of yrs. of exposition, individual data not listed; **sign. cross-shift decrease in exposed
Various Woods (Abies, Chestnut, Douglas, Framire, Mansonia, Oak, Obeche, Walnut, White poplar)	★	9	Carosso, Ruffino et al., 1987	2-; cross-sectional	90	9 (10)	20/90	22.2	nd		nd		nd		nd		20/90	22.2	*		**		nd		nd			12/90	13.3	1/90	1.1		Wood workers. *Sign. neg. correlation between FEV1, FEF50, TLco, Kco and duration of exposure; **all 20 asthmatics NSBHR+; sign. higher prevalence of SPT+ in asthmatics, 9 asthmatics SPT+	
Wood dust (not specified)	■	-	Holness, Sass-Kortsak et al., 1985	2-; cross-sectional	50	[9 (18)]	9/50	18	16/50	32	10/50	20	19/50	38	5/50	10	nd		*		nd		**		nd								Cabinet makers. *Sign. inverse correlation between FEV1, FEF75, and exposure index; **sign. decline in FEV1 and FVC cross-workshift in 48 exposed	
Various woods (not specified)	■	-	Agwu, Okeke et al., 2007	3+; cross-sectional	591	[56 (6.3)*]	56/591	6.3	401/591	78	nd		nd		nd		nd		nd		251/591*	42.5	nd		nd									Woodworkers. *No allergy test was done. Asthma was confirmed by presence of wheezing and breathlessness. The ratio of observed PEFR and predicted PEFR (%) <75% was considered as abnormal.
Various woods	■	-	Kersten and von Wahl, 1994	3; case series	157	*	157/157		nd		nd		nd		157/157		nd		nd		nd		nd		*								157 wood-workers claiming for compensation due to OA. Number of subjects per species exposed not listed; *positive SPTs were found with 33 different wood species	
Ash	■																																	
Beech	■																																	

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							WORK-RELATED SYMPTOMS												LFT		NSBHR		sPFT		SIC				SPT			Spec. IgE					
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n	%	n/n	%	n/n	%	n/n	%	n/n	%	n/n	%		n/n	%	n/n	%		
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%	n/n LFT	%	n/n NSBHR	%	n/n PFT	%	n/n SIC	%	i	(n)	l	(n)	d	(n)	n/n SPT	%	n/n IgE	%	
Gaboon																									4/90	4.4							14/264	5.3			out of 45 species tested
Fir																									3/90	3.3							12/261	4.6			
Kambala																									7/90	7.8							14/264	5.3			
Limba																									2/90	2.2							7/259	2.7			
Mahogany, american																																	21/263	8.0			
Makore																									14/90	15.6							30/263	11.4			
Mansonia																									4/90	4.4							10/263	3.8			
Meranti																									6/90	6.7							6/261	2.3			
Oak																									10/90	11.1							24/264	9.1			
Obeche																									20/90	22.2							31/263	11.8			
Pine																									5/90	5.6							14/264	5.3			
Sapelli																									2/90	2.2							4/267	1.5			
Spruce																									2/90	2.2							22/262	8.4			
Walnut																									2/90	2.2							5/263	1.9			
Various woods (Ash, Beech, Limba, Mahogany, Makore, Oak, Obeche, Red Cedar, Teak)	(*)	11	Oertmann and Bergmann, 1993	3+; case series	55	11 (20)	55/55	100	+	+	+	-	+	+	-	+	-	17/55	30.9	40/55	72.7	nd	nd	18/55	32.7							29/55**	52.7			55 wood-workers claiming for compensation due to OA. *Individual symptoms and number of subjects per species exposed not listed; **IC; 11 SIC+ were also IC+	
Ash																									2/2								8/55	14.5			
Beech																									1/2								9/55	16.4			
Limba																									1/3								9/55	16.4			
Mahogany																									2/4								9/55	16.4			
Makore																									4/5								15/55	27.3			
Oak																									1/3								9/55	16.4			
Obeche																									6/8								11/55	20.0			
Red Cedar																									1/1								0/55	0			
Teak																									1/2								1/55	1.8			
Various woods (obeche, lanan, mahogany, samba, mansonia, ramini)	-	-	Fasani, Pisati et al., 1982 ABSTRACT	3+; case series	55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1/1*								10/55**	18.2			Woodworkers. *SIC+ to mansonia and ramini; **SPT+ to at least one wood dust	
Exotic woods	-	-	Colas, Grossclaude et al., 1985 ABSTRACT	3+; case series	10	-	10/10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10 woodworkers with OA due to exotic woods	
Rimu (<i>Dacrydium cupressinum</i>) and other wood dust (Kauri (<i>Agathis australis</i>), Tawa (<i>Beilschmedia tawa</i>) etc.)	-	-	Norrish, Beasley et al., 1992	2+; cross-sectional	50	[5 (10)]	11/44	25	32/44	72.7	32/44	72.7	14/44	31.8	nd	nd	nd	nd	nd	nd	nd	nd	nd	5/41*	12.2	nd						nd	nd			Wood workers. *Serial PEF for 10 days	
HARDWOOD																																					
Family Bignoniaceae																																					
Ipe, Brazilian walnut (<i>Tabebuia</i> spp.)	-	2	Algranti, Mendonca et al., 2005	3; case report	1	1	1/1		nd		nd		nd		nd		1/1		1/1		nd		nd		1/1			1		1/1		0/1				Woodworker	
Bethabara wood, <i>Tabebuia</i>			Yacoub, Lemiére et al., 2005	3; case report	1	[1]	1/1		0/1		0/1		1/1		0/1		1/1		1/1		1/1		nd		1/1			1		nd		nd		nd		Railway platform fitter	
Family Ebenaceae																																					
Ebony wood (<i>Diospyros crassiflora</i>)	-	-	Maestrelli, Marcer et al., 1987	3; case report	1	[1]	1/1		nd		nd		1/1		0/1		1/1		1/1		nd		nd		1/1			1		0/1*		nd				Carpenter. *IC	
			Kopferschmitt-Kubler, Bachez et al., 1992 ABSTRACT	3; case report	1	[1]	1/1		-		-		-		-		-		-		-		-		1/1			1		-		-				Violin and stringed instrument maker	
Family Fagaceae																																					
Beech (<i>Fagus sylvatica</i>)	-	-	Spiewak, Bozek et al., 1994	3; case report	1	[1]	1/1		1/1		1/1		0/1		0/1		1/1		0/1		nd		nd		1/1			1*		1**		0/1		nd		Carpenter co-exposed to ash, oak and pine. *Wood dust; **aqueous extract	
Cabreuva (<i>Myrocarpus frondosus</i>)	-	1	Pala, Pignatti et al., 2010	3; case report	1	1	1/1		1/1		1/1		1/1		nd		0/1		1/1		nd		nd		1/1*			1		0/1		nd*				Parquet floor layer. * Increase in CD4 lymphocytes after SIC. Occupational rhinitis was also diagnosed.	
Oak (<i>Quercus robur</i>)	-	-	Malo, Cartier et al., 1995	3; case reports	3	[3]	3/3		1/3		nd		3/3		nd		3/3		1/1		3/3		1/1		3/3			1		2		0/3		nd		Carpenters	
			Sosman, Schlueter et al., 1969	3; case report	1	[1]	1/1		1/1		nd		1/1		nd		1/1		0/1		nd		nd		1/1			1		0/1		nd				Lumber-mill worker. See also cedar and mahogany	
Oak (<i>Quercus</i> sp.)			Spiewak, Bozek et al., 1994	3; case report	1	[1]	1/1		1/1		1/1		0/1		0/1		1/1		0/1		nd		nd		1/1			1*		1**		0/1		nd		Carpenter co-exposed to ash, beech and pine. *Wood dust; **aqueous extract	
Family Juglandaceae																																					

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							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE						
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction			n/n SPT	%	n/n IgE	%			
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%						i	(n)	l
Central American walnut (<i>Juglans olanchana</i>)	■	-	Bush and Clayton, 1983	3; case report	1	[1]	1/1		1/1		nd		1/1		nd		1/1		nd		1/1		1			0/1*		0/1		Woodworker. *IC				
Family Lauraceae																																		
Imbuia (<i>Phoebe porosa</i>), Brazilian Walnut	■	1	Jeebhay, Prescott et al., 1996	3; case report	1	[1]	1/1		1/1		nd		1/1		nd		1/1		nd		x*		1/1		1			nd		0/1		Joinery worker. *Serial PEFR for 2 weeks showed substantial variability, but no specific work-related pattern		
Family Leguminosae																																		
African Zebra wood (<i>Microberlinia</i>)	■	1	Bush, Yunginger et al., 1978	3; case report	1	1	1/1		nd		nd		1/1		nd		1/1		0/1		nd		nd		1/1		1	1/1*		1/1		Woodshop worker. * IC		
Angelim pedra (<i>Hymenolobium petraeum</i>)	■	1	Alday, Gómez et al., 2005	3; case report	1	1	1/1		1/1		1/1		nd		1/1		nd		1/1		nd		1/1		1			1/1		1/1		Carpenter		
Blackwood (<i>Acacia melanoxylon</i>)	■	-	Wood-Baker and Markos, 1997	3; case reports	3	[3]	3/3		1/3		nd		3/3		1/3		3/3		2/3		3/3		3/3		2	1		nd		nd		Cabinet-maker, furniture-makers		
Cabruva (<i>Myrocarpus fastigiatus</i> Fr. All.)	■	-	Innocenti, Romeo et al., 1991	3; case report	1	[1]	1/1		nd		nd		1/1		nd		1/1		0/1		0/1		nd		1/1		1		nd		nd		Parquet floor layer	
Cadorana (<i>Cedrelinga catenaeformis</i>)	■	1	Alvarez Eire, Pineda et al., 2006	3; case report	1	1	1/1		1/1		1/1		1/1		nd		nd		0/1		0/1		nd		1/1		1		1/1		1/1		Carpenter. Co-exposure to other woods.	
Cocabolla (<i>Dalbergia retusa</i>)	■	1	Eaton, 1973	3; case reports	3	1	2/3		3/3		nd		2/3		1/3		3/3		2/3		nd		nd		nd		2/3		nd		nd		Billiard cue manufacture workers	
Fernambouc (<i>Caesalpinia echinata</i> or <i>Guilandia echinata</i>)	■	1	Hausen and Herrmann, 1990	3+; survey	36	1 (2.8)	9/36	25	6/36	16.7	4/36	11.1	9/36	25	nd		12/36	33.3	nd		1/1		nd		1/1*		1		1/12*	8.3	0/12		Music-instruments-makers. *SPT and SIC in symptomatics	
Jatoba wood (<i>Hymenaea courbaril</i>)	■	-	Quirce, Parra et al., 2004	3; case report (letter)	1	[1]	1/1		1/1		0/1		0/1		0/1		1/1		0/1		1/1		1/1		1			0/1		0/1		Carpenter co-exposed and co-sensitized to tali; see tali		
Kejaat (<i>Pterocarpus angolensis</i>)	■	1	Ordman, 1949	3; case report	1	1	1/1		nd		nd		1/1		nd		1/1		nd		nd		nd		nd			1/1*		nd		Wood-machinist. Improvement of asthmatic symptoms after desensitization with an extract of Kejaat; * IC		
Locust wood (<i>Robinia pseudoacacia</i> L.)	■	2	Kespohl, Merget et al., 2006	3; case reports	2	2	2/2		1/2		1/2		nd		nd		2/2		1/2		1/1		nd		1/1		1		1/1		2/2		Mechanic with 1 high-exposure incident to Locust wood and 1 carpenter.	
Palisander, Brazilian rosewood (<i>Dalbergia nigra</i>)	■	1	Godnic-Cvar and Gomzi, 1990	3; case report	1	1	1/1		1/1		1/1		1/1		1/1		1/1		0/1		0/1		nd		1/1		1		1/1*		nd		Joiner. *IC	
Tali wood (<i>Erythrophleum suaveolens</i>), elondo, missanda, muave	■	-	Quirce, Parra et al., 2004	3; case reports (letter)	2	[2]	2/2		2/2		1/2		1/2		0/2		2/2		0/2		2/2		2/2		2/2		1	1	0/2		0/2		Carpenters. 1/2 co-exposed and co-sensitized to jatoba; see jatoba	
Family Meliaceae																																		
Mahogany	■	-	Sosman, Schlueter et al., 1969	3; case report	1	[1]	1/1		nd		nd		1/1		nd		1/1		1/1		1/1		nd		nd		1/1		1	0/1		nd		Patternmaker. See also cedar and oak
Sapele wood	■	1	Alvarez-Cuesta, Ortiz et al., 2004	3; case report	1	1	1/1		1/1		1/1		nd		1/1		1/1		nd		nd		nd		nd				0/1		1/1		Carpenter	
Family Moraceae																																		
Antiaris (<i>Antiaris africana</i> or <i>Antiaris toxicaria</i>)	■	1	Higuero, Zabala et al., 2001	3; case report	1	1	1/1		1/1		1/1		1/1		nd		1/1		0/1		1/1		nd		1/1			1	1/1		1/1		Woodworker	
Iroko (<i>Cholophora excelsa</i>)	(*)	5	Ricciardi, Fedele et al., 2003	3+; case reports	9	4 (44.4)	9/9		nd		nd		9/9		nd		9/9		nd		9/9		9/9		9/9		9	4/9*		0/9		9 woodworkers with clinically proven OA to iroko were compared to 10 asymptomatic woodworkers and to 10 asthmatic woodworkers. *I.C.; all controls were SPT-, IgE-, PFT- and SIC- to iroko		
*			Azofra and Olaguibel, 1989	3; case report	1	[1]	1/1		1/1		1/1		1/1		nd		1/1		0/1		1/1		nd		1/1		1	0/1		nd		Carpenter		
*			Pickering, Batten et al., 1972	3; case report	1	1	1/1		nd		nd		nd		nd		1/1		0/1		nd		nd		1/1		1*	1**		1/1		nd		Carpenter. *Aqueous extract; ** wood dust
Family Oleaceae																																		
Ash (<i>Fraxinus americana</i>)	■	1	Malo and Cartier, 1989	3; case report	1	[1]	1/1		1/1		nd		nd		nd		1/1		0/1		1/1		1/1		1/1		1		nd		0/1		Furniture maker	

Agents	Strength of evidence per agent (three star system of RCGP)	Total no. of allergic asthma cases per agent, n	Reference	Level of evidence per study (revised SIGN grading system); study type.	Occupationally exposed subjects studied, n	Allergic asthma cases due to mentioned agent, n, prevalence (%). Cases with probable allergic asthma but specific sensitization not confirmed in parentheses [] or not indicated.	EVIDENCE (pathological results)																				Remarks					
							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE				
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction			n/n SPT	%	n/n IgE	%	
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%						i
Ash (<i>Fraxinus excelsior</i>)			Fernández-Rivas, Pérez-Carral et al., 1997	3; case report	1	1	1/1		1/1		1/1		nd		1/1		0/1		1/1		1/1*		1/1				1	1/1**		1/1		Furniture factory worker. *Serial PEFR at work and off work for 2 weeks; **SPT-, IC+
Ash (<i>Fraxinus excelsior</i>)			Spiwak, Bozek et al., 1994	3; case report	1	[1]	1/1		1/1		1/1		0/1		0/1		0/1		nd		nd		1/1		*	**	0/1		nd		Carpenter co-exposed to oak, beech and pine. *Aqueous extract; **wood dust	
Family Rhamnaceae																																
Cascara sagrada bark (<i>Rhamnus purshiana</i>)	-	1	Giavina-Bianchi, Castro et al., 1997	3; case report	1	1	1/1		1/1		1/1		1/1		1/1		0/1		1/1		nd		1/1				1	1/1		1/1		Pharmacy worker co-exposed and co-sensitized to <i>Passiflora alata</i>
Family Rosaceae																																
Soapbark (<i>Quillaja saponaria</i>)	-	1	RaghuPrasad, Brooks et al., 1980	3; case report	1	1	1/1		1/1		1/1		1/1		nd		1/1		0/1		1/1		1/1		1		nd		1/1		Saponin-production worker. RAST: cross-reactivity with gum acacia and gum tragacanth	
Family Rutaceae																																
Pau marlin (<i>Balfourodendron riedelianum</i>)	-	1	Basomba, Burches et al., 1991	3; case report	1	1	1/1		1/1		nd		nd		1/1		1/1		nd		nd		1/1		1		1/1*		1/1		Carpenter. *IC	
Family Sabotaceae																																
Abirua	-	2	Booth, LeFolkt et al., 1976	3; case reports	2	2	2/2		1/2		nd		2/2		nd		2/2		nd		nd		2/2*		1	1	2/2**		nd		Workers in a furniture factory. *SIC with aqueous extract; **1/1 IC+, 1/1 scratch test+	
Makore, African cherry wood (<i>Tighehella heckelii</i>)	-	-	Obata, Dittick et al., 2000	3; case report	1	[1]	1/1		nd		nd		1/1		nd		1/1		0/1		1/1		1/1		*	**	0/1		nd		Carpenter. *SIC with wood dust; **SIC with aqueous extract	
Tanganyika aningré	-	2	Paggiaro, Cartalupi et al., 1981	3; case reports	3	2 (66.6)	3/3	100	2/3	66.6	1/3	33.3	2/3	66.6	nd		3/3	100	1/3	33.3	2/2	100	nd	2/3	66.6	2		3/3*	100	0/3	0%	Woodworkers. *IC
Family Sterculiaceae																																
African Maple (<i>Triplochiton scleroxylon</i>), Whitewood, Samba, Obeche, Wawa	(*)	16	Quirce, Hinojosa et al., 2000	3+; case series	5	5	5/5		5/5		nd		5/5		nd		5/5		nd		nd		2/2*		3		5/5		5/5		Woodworkers. *2 subjects who didn't undergo SIC were PFT+	
*			Ferrer, Maranon et al., 2001 ABSTRACT	3; case report	1	1	1/1		nd		nd		nd		nd		nd		nd		nd		1/1				1/1		1/1		Worker exposed to <i>Triplochiton scleroxylon</i>	
*			Pontier, Popin et al., 2002 ABSTRACT	3; case report	1	1	1/1		1/1		nd		nd		*		1/1		nd		nd		1/1*				1/1		1/1		Worker exposed to abachi wood. * LFT showed airway obstruction, nasal challenge test was also positive.	
*			Hinojosa, Losada et al., 1986	3; case reports	4	4	4/4		4/4		nd		nd		nd		4/4		nd		nd		4/4		4		4/4		4/4		2 sawmill workers co-exposed to Ramin, 1 woodcarver, and 1 carpenter. REIA: cross-reactivity with Ramin; see also Ramin	
*			Hinojosa, Moneo et al., 1984	3; case reports	2	2	2/2		2/2		1/2		1/2		nd		2/2		1/2		nd		1/1		1		2/2		2/2		Woodworker and construction worker with tracheotoma.	
*			Rejula, Kujala et al., 1994	3; case reports	2	2	2/2		2/2		nd		2/2		nd		2/2		1/2		1/2		2/2		2		2/2		2/2		Carpenters	
*			Weber and Häufinger, 1988	3; case report	1	1	1/1		1/1		0/1		0/1		1/1		1/1		1/1		nd		1/1			1	1/1*		1/1		Woodworker. *IC	
Family Thymelaeaceae																																
Ramin (<i>Gonyostylus bancanus</i>)	-	2	Hinojosa, Losada et al., 1986	3; case reports	2	2	2/2		2/2		nd		nd		2/2		nd		nd		nd		2/2		2		2/2		nd		Sawmill workers. Co-exposure to African maple	
*			Howie, Boyd et al., 1976	3; case report	1	[1]	1/1		nd		nd		1/1		nd		1/1		0/1		nd		1/1			1		0/1		nd		Wood worker. IgG+ with Ramin. Diagnosis of extrinsic allergic alveolitis
SOFTWOOD																																
Family Cupressaceae																																

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							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE				
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction			n/n SPT	%	n/n IgE	%	
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%						i
California Redwood (<i>Sequoia sempervirens</i>)	-	-	Chan-Yeung and Abboud, 1976	3; case reports	2	[2]	2/2		2/2		nd	1/2		nd	2/2		1/2		nd		nd		2/2			2	0/2		nd		Carpenter and furniture-maker	
			doPico, 1978	3; case report	1	[1]	1/1		1/1		nd	1/1		nd	1/1		1/1		nd		nd		1/1		1	0/1		nd		Retired carpenter		
Eastern white cedar (<i>Thuja occidentalis</i>)	*	1	Malo, Cartier et al., 1994	2; cross-sectional	42	[3 (7.1)]	25/42	59.5	nd	nd	nd	nd	nd	nd	nd	0/42	0	18/42	42.9	nd	nd	3/12*	25	1	1		nd		nd		Sawmill workers. *SIC in NSBHR+ only, 1/10 SIC+ with plicatic acid (immediate), 1/3 SIC+ with western red cedar (late), 1 subject underwent SIC to both of these agents, 1 subject had sign. changes in PC20 each time he was exposed to Th. occ. but no changes in FEV1	
			Cartier, Chan et al., 1986	3; case report	1	1	1/1		nd		nd	1/1		nd	1/1		0/1		1/1		1/1*	1/1**		1		nd		1/1***		Sawmill worker. *Serial PEFR at work and off work for 6 weeks; **SIC with plicatic acid and with western red cedar; ***IgE with plicatic acid		
Western red cedar (<i>Thuja plicata</i>)	**	323	Chan-Yeung, Vedal et al., 1984	2; cross-sectional	652	1 (0.2)	27/652	4.1	nd	nd	110/652	16.9	nd	nd	nd	x*		94/485	19.4	nd	nd						1/652	0.15	nd		Cedar mill workers. Exposed had sign. higher prevalence of asthma and NSBHR+, and *sign. lower FEV1/FVC	
			Noertjojo, Dimich-Ward et al., 1996	2; longitudinal study	243	*	*		nd	nd	nd	nd	nd	nd	nd	**		nd	nd	nd	nd	nd							nd		11 yr follow-up of lung function of non-asthmatic sawmill workers. *20 subjects with physician diagnosed asthma (not clear whether WR) were excluded from the follow-up; 20/243 had wheezing during initial survey (not clear whether WR); **sign. annual declines in FEV1 and FVC in non-asthmatics showed dose-response relat. between level of exposure and the annual decline in FVC	
			Chan-Yeung, Lam et al., 1982	2; case series with follow-up	125	[125 (100)]	125/125		50/125		nd	109/125		nd	125/125		27/125		55/55		nd	nd	125/125	12	54	59		nd		nd		125 subjects with OA re-examined after 1-9 years: all 50 still exposed and 37/75 no longer exposed remained asthmatic; persistence of symptoms related to longer duration of both exposure and symptoms prior to diagnosis, and also to higher bronchial responsiveness
			Mue, Ise et al., 1975	2; cross-sectional	154	19 (12.3)	38/154	24.7	45/154	29.2	45/154	29.2	33/154	21.4	nd	116/154	75.3	nd	nd	nd	nd	23/154	14.9	23			86/154*	55.8	nd		Workers of wooden frame factories. *IC; 19/23 SIC+ were IC+	
			Ishizaki, Shida et al., 1973	3+; cross-sectional	1320	22 (1.7)	45/1320	3.4	124/1320	9.4	125/1320	9.5	nd	59/1320	4.5	303/1320	23	nd	nd	nd	nd	nd					22/26*	85	nd		Furniture factory workers. *IC done in asthmatics	
			Paggiaro and Chan Yeung, 1987	3+; case series	332	32 (9.6)	332/332		nd	nd	nd	nd	nd	nd	332/332		+	+	nd	nd	nd	332/332	31	##	157		nd		32/138	23.2	332 patients with OA due to WRC. Clinical tests done with plicatic acid; *subjects with dual response had sign. lower FEF25-75 and sign. lower mean PC20 compared to patients with other patterns of response	
			Chan-Yeung, MacLean et al., 1987	3+; case series with follow-up	232	232 (100)	232/232	100	nd	nd	nd	nd	nd	232/232	100	+	+	+	+	nd	nd	232/232	100	25	97	109		nd		+	232 patients with new-onset OA observed ~4 years after the initial diagnosis: 136/232 had no further exposure, 55 of them were asymptomatic and 81 of them symptomatic at follow-up; all 96 with continued exposure were symptomatic; *Sign. higher in asymptomatics at time of diagnosis and at follow-up; **sign. higher PC20 in asymptomatics; ***no sign. difference	
			Tse, Chan et al., 1982	3+; case series	28	8 (28.6)	28/28	100	nd	nd	nd	nd	nd	28/28	100	nd	nd	nd	nd	nd	nd	18/28	64.3	2	9	7		nd		8/18*	44.4	Wood workers suspected to have OA due to WRC. *IgE done with plicatic acid and crude cedar in SIC+ subjects only
			Côté, Kennedy et al., 1990	3+; case series	23	[14 (60.9)]	18/23	78.3	nd	nd	nd	nd	nd	23/23	100	nd	nd	11/23*	47.8	13/23**	56.5	14/23***	60.9	14			nd		nd		Sawmill workers. *Sign. decrease in PC20 after returning to work by SIC+ subjects; **serial PEFR for 2 weeks off-work and for 3 weeks at work; significant decrease at work by SIC+ subjects; ***SIC with plicatic acid	
			Chan-Yeung, Barton et al., 1973	3+; case series with follow-up	22	3 (13.6)	18/22	81.8	12/22	54.5	nd	nd	nd	22/22	100	12/18	66.6	nd	nd	nd	nd	18/22	81.8	4	8	6	3/22	13.6	nd		Woodworkers. 0/22 SPT+ with plicatic acid; 16/16 SIC+ with plicatic acid (4 immediate, 5 late, 7 dual)	
			Gandevia and Milne, 1970	3+; case series	10	3 (30)	6/10	60	8/10	80	nd	5/10	50	nd	10/10	100	6/10	60	nd	nd	nd	4/4	100	4	2	6/9	66.6	nd		Woodworkers. All 6 asthmatics were LFT+; SIC done only in asthmatics; 3/4 SIC+ asthmatics were SPT+		
			Chan-Yeung and Desjardins, 1992	3; case reports with follow-up	4	[4]	4/4		2/4		nd	nd	nd	4/4		0/4		4/4		nd	nd	4/4*	3	1	1		nd		0/4*		Sawmill workers. *SIC and IgE with plicatic acid	
			Chan-Yeung, Barton et al., 1971	3; case reports	3	3	3/3		2/3		2/3	2/3		nd	3/3		2/3		nd	nd	nd	3/3		1	2		3/3*		nd		Wood workers. *I.C.(immediate)	
			Pickering, Batten et al., 1972	3; case report	1	[1]	1/1		1/1		nd	nd	nd	1/1		0/1		nd		nd	nd	1/1		1		0/1		nd		Carpenter		

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							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE		
							Asthma	Rhinitis	Conjunct.	Cough	Skin	Total																		
n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%	n/n LFT	%	n/n NSBHR	%	n/n PFT	%	n/n SIC	%	i (n) l (n) d (n)	n/n SPT	%	n/n IgE	%						
Family Pinaceae																														
Cedar of Lebanon (<i>Cedra libani</i>)	-	1	Greenberg, 1972	3+; case series	6	1	6/6		2/6		nd	4/6		nd	6/6		0/5		nd		nd				1/6		nd	Workers at joinery works		
Cedar			Sosman, Schlueter et al., 1969	3; case reports	2	[2]	2/2		nd		nd	nd		2/2		nd		nd		nd		1/1		1	0/1		nd	Carpenters. See also oak and mahogany		
Pine and Spruce	[*]	1	Hessel, Herbert et al., 1995	2-; cross-sectional	94	[7 (7.4)]	7/94*	7.4	nd		nd	nd		nd		nd		nd		nd		nd				nd	Sawmill workers. *Current asthma, not clear whether WR; **sign. decreased FEV1 and FEV1/FVC in exposed			
Pine (<i>Pinus radiata</i>)			Douwes, McLean et al., 2001	3+; survey	704	[127 (18)]	127/704	18	+	+	+	+		nd		nd		nd		nd		nd				nd	Pine sawmill workers from 5 large sawmills. *Sign. increased in exposed; **more common in exposed			
Pine (<i>Pinus sylvestris</i>)			Spiewak, Bozek et al., 1994	3; case report	1	[1]	1/1		1/1		1/1	0/1		0/1		nd		1/1			1	0/1				nd	Carpenter co-exposed to ash, oak and beech			
Pine (<i>Pinus sylvestris</i>)			Skovsted, Schlünssen et al., 2000	3; case report	1	1	1/1		1/1		nd	nd		1/1		0/1*		nd				1/1				nd	Furniture maker. *Serial PEFR during working days and off-work			
Pine and wood boards	*	9	Schlünssen, Skovsted et al., 2004	2-; cross-sectional	365	9 (2.5)**	82/365	22.5	nd		nd	nd		nd		nd		nd				36/365	9.9	9/365	2.6	Woodworkers. Random sample of persons reporting asthma symptoms, rhinitis symptoms, and no respiratory symptoms in a questionnaire from 1997-1999 (Schlünssen et al. 2002). *54/365 had asthma symptoms and NSBHR+. Spec. IgE measured only for pine. **Highest ORs found for asthma in relation to Spec. IgE for pine.				
Coniferous trees (Black spruce (<i>Picea mariana</i>), balsam fir (<i>Abies balsamea</i>), jack pine (<i>Pinus banksiana</i>))	-	-	Malo, Cartier et al., 1986	3; case series	11	[11]	11/11		6/11		6/11	nd		11/11		2/11		11/11		11/11*		0/4				nd	Sawmill employees. *Sign. changes in PEFR at work as compared with periods off work			
MUSHROOMS, MOLDS (FUNGI)																														
Edible mushrooms																														
<i>Psalliota hortensis</i> , <i>Boletus edulis</i> , <i>Champignon de Paris</i>	(*)	8	Symington, Kerr et al., 1981	3+; case series	8	4 (50)	+	+	nd		nd	8/8		1/1		nd		nd		4/8		4		5/8	62.5	nd	Employees in a food manufacturing factory. *Individual WRS not given; clinical tests with dried mushroom extract			
<i>Boletus edulis</i>			Foti, Eustachio et al., 2008	3; case report	1	1	1/1		nd		nd	nd		0/1		1/1		nd		1/1		1	nd		1/1		Worker in a pasta factory.			
<i>Boletus edulis</i>			Toricelli, Johannson et al., 1997	3; case reports	3	3	3/3		1/3		1/3	nd		3/3		0/2		1/1		nd		2/2	1	1	3/3	3/3	Office worker in food company, indirectly exposed, cook, and housewife.			
<i>Pleurotus cornucopiae</i>	-	1	Michlis, De Vuyst et al., 1991	3; case report	1	1	1/1		nd		nd	1/1		0/1		1/1		1/1*		nd					1/1		Worker in a factory producing a single type of mushroom. *Serial PEFR at work and off-work for 1 week			
<i>Pleurotus ostreatus</i>	-	1	Vereda, Quirce et al., 2008	3; case report	1	1	1/1		nd		nd	1/1		0/1		1/1		nd		1/1		1	1/1		1/1		Seller of fruits and vegetables.			
<i>Saccharomyces cerevisiae</i> , powdered dehydrated yeast	-	1	Belchi-Hernandez, Mora-Gonzalez et al., 1996	3; case report	1	1	1/1		1/1		nd	1/1		1/1		1/1*		1/1		1		1/1		1/1		1/1	Baker, not sensitized to other baking allergens/additives; SIC- with other baking additives; *serial PEFR at work and off-work for 2 weeks			
Molds, other fungi																														
<i>Aspergillus mix</i>	-	1	Klaustermeyer, Bardana et al., 1977	3; case report	1	1	1/1		nd		nd	1/1		1/1		nd		nd		1/1				1	1/1*	nd	Baker. *IC+ with rye and with various molds (<i>Aspergillus</i> most reactive); SIC- with rye			
<i>Aspergillus niger</i>	*[*]	12	Topping, Scansbrink et al., 1985	2-; cross-sectional	343	9 (2.6)	18/343	5.3	*	*	*	nd		78/343		nd		nd		nd					17/343	5.0	11/26**	Workers of a biotechnology plant. **Respiratory symptoms other than asthma; **SPT+ and asthmatics tested; 9/18 asthmatics sensitized; subjects with WRS had sign. increased prevalence of sensitization		
*			Seaton and Wales, 1994	3+; cross-sectional with follow-up	261	3 (1.1)	10/261	3.8	nd		nd	+		78/261	29.9	nd		nd		nd					25/261	9.6	nd	261 original and 76 new employees of biotechnology plant. 78/261 original and 5/76 new employees had respiratory WRS; 3/10 asthmatics were SPT+		
<i>Aspergillus fumigatus</i>	-	1	Allmers, Huber et al., 1997	3; case report	1	1	1/1		nd		nd	1/1		0/1		nd		nd		1/1		1		1/1		1/1	Refuse collection worker co-exposed and co-sensitized to other fungi. Diagnosis: ABPA (allergic bronchopulmonary aspergillosis)			
*	-	1	Baz, Hinojosa et al., 1999	3; case report	1	1	1/1		1/1		1/1	nd		1/1		1/1		nd		1/1		1	1/1		1/1		Stucco maker exposed to esparto fibers contaminated with <i>Aspergillus fumigatus</i> .			

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							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE		
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	n/n NSBHR	n/n PFT	n/n SIC	Reaction			n/n SPT		n/n IgE		
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%					% i	% n	% l				% d	% n
<i>Alternaria</i>	[*]	8	Menzies, Comtois et al., 1997	2-, cross sectional	214	7 (3.3)	36/169*	21.3	87/169*	51.5	nd	66/169*	39	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	18/169	10.65	nd	Office workers exposed to fungal and house dust mite (see HDM) aeroallergens. <i>Alternaria</i> allergen was significantly associated with respiratory symptoms. The population-attributable risk for work-related respiratory tract symptoms was 9.5% for <i>Alternaria</i> . * Dyspnea was interpreted as asthma, Sneezing as rhinitis.	
<i>Alternaria</i>			Klaustermeyer, Bardana et al., 1977	3; case report	1	1	1/1		nd	nd	nd	1/1	nd	nd	nd	nd	nd	nd	1/1	1					1/1*		nd	Baker. * IC+ with <i>Alternaria</i> , IC- with rye and wheat		
<i>Chrysomilia sitophila</i> , common red bread mold		3	Tarlo, Wai et al., 1996	3; case report	1	1	1/1		1/1	1/1	1/1	1/1	nd	1/1	0/1	1/1	1/1	1/1	nd						1/1		1/1	Logging worker. SPT- with wood.		
			Monzn, Ledesma et al., 2009	3; case report	1	1	1/1		1/1	1/1	1/1	1/1	nd	nd	0/1	nd	1/1	1/1	1						1/1		1/1	Worker in a coffee company.		
			Francuz, Yera et al., 2010	3; case report	1	1	1/1		1/1	1/1	1/1	1/1	nd	nd	0/1	1/1	1/1	1/1	nd						1/1*	1/1*	Coffee dispenser operator. *SPT+ and Spec.IgE+ for grass pollen and birch pollen			
<i>Dictyostelium discoideum</i> , slime mould		1	Gottlieb, Garibaldi et al., 1993	3; case report	1	1	1/1		1/1	1/1	nd	nd	1/1	nd	nd	nd	1/1	nd	nd						1/1		1/1	Laboratory worker		
<i>Mucor</i>		1	Enriquez, Fernández et al., 2011	3; case report	1	1	1/1		nd	1/1	nd	nd	nd	nd	0/1	1/1	0/1*	1/1	1					1/1		1/1	Stucco maker exposed to esparto fibers. PFT decrease nn significant but suggesting an occupational relationship.			
<i>Neurospora sp.</i>		2	Côté, Chan et al., 1991	3; case report	1	1	1/1		1/1	nd	1/1	nd	nd	1/1	0/1	1/1	nd	1/1	1						1/1		1/1	Plywood factory worker		
			Heffler, Nebiolo et al., 2009	3; case report	1	1	1/1		nd	nd	nd	nd	nd	nd	0/1	1/1	1/1	1/1	nd						1/1*	1/1	Coffee dispenser operator. *SPT+ for mix of fungi extracts.			
<i>Penicillium camemberti</i>		1	Merget, Sander et al., 2008	3; case report	1	1	1/1		1/1	nd	nd	1/1	nd	1/1*	nd	nd	nd	nd							1/1		1/1	Sausage packer. *FEV1: 49% predicted, FEV1/FVC:79% predicted. Bronchial challenge not performed due to patient's airway obstruction.		
<i>Plasmopara viticola</i> , pseudo mildew of grapevine		1	Wenzel Schaubschläger, Becker et al., 1994	3; case report	1	1	1/1		1/1	nd	nd	nd	1/1	0/1	1/1	nd	nd	0/1							1/1		1/1	Greenhouse worker co-exposed and co-sensitized to <i>Alternaria</i>		
<i>Rhizopus nigricans</i>		1	Gamboa, Jáuregui et al., 1996	3; case report	1	1	1/1		1/1	nd	1/1	nd	1/1	0/1	nd	nd	nd	1/1	1						1/1		1/1	Coal miner co-exposed but not sensitized to other molds		
<i>Scopulariopsis brevicaulis</i>		-	Lander, Jepsen et al., 1988	3; case report	1	[1]	1/1		nd	nd	1/1	nd	1/1	nd	nd	nd	nd	1/1						1	nd	nd	nd	A tobacco worker. IgG+ to <i>Scopulariopsis brevicaulis</i>		
<i>Sporobolomyces salmonicolor</i>		-	Seuri, Husman et al., 2000 ABSTRACT	3+; survey	14	[4 (28.6)]	4/14		nd	nd	9/14	nd	13/14	nd	nd	nd	nd	4							0/14	nd	nd	Employees of a water-damaged building. 7/14 nasal Ch+		
Mold fungi		-	Bergmann, Rebohle et al., 1976	3+; survey	32	-*	-		*	nd	*	nd	*	nd	nd	nd	nd	nd								16/30	53.3	Bakers. *1/3 of 32 had WRS (rhinitis, asthma, bronchitis), individual data not listed; 9/30 IC+ with flour		
<i>Mucor</i>																									8/30	26.7				
<i>Aspergillus</i>																									22/30	73.3				
Fungus mixture																														
Mold fungi				3+; case series; retrograde analysis	179	-*	-		nd	nd	nd	nd	179/179	nd	nd	nd	nd	nd								81/179	45	*Retrospective analysis of IC tests of 179 bakers with allergic airway disease. Prevalence of sensitization sign. higher in symptomatics		
<i>Mucor</i>																									23/54	43				
<i>Cladosporium</i>																									36/179	32				
<i>Aspergillus</i>																									59/168	35				
Fungus mixture																														
MICROSCOPIC ORGANISMS (PROTOCTISTAE)																														
<i>Chlorella</i> (Algae)		1	Ng,Tan et al., 1994	3; case report	1	1	1/1		1/1	1/1	1/1	1/1	nd	1/1	nd	1/1	1/1*	1/1							1	1/1	nd	Pharmacist. *Serial PEFR for 7 working days and 13 days off		
ENZYMES																														
Alpha-amylase from <i>Aspergillus oryzae</i>	**	29	Brisman, Nieuwenhuijsen et al., 2004	2+; cohort study (prospective)	300	[incidence rate: 3]	36/300	12*	86/300	28.7*	86/300	28.7*	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	24/300	8*	nd	Bakers and millers. *3 year incidence; sign. increased prevalence ratio (PR) of 3.0 for chest symptoms in the highest exposure category; 21/300 SPT with flour; sensitized asthmatics not listed	

Agents	Strength of evidence per agent (three star system of RCGP)	Total no. of allergic asthma cases per agent, n	Reference	Level of evidence per study (revised SIGN grading system); study type.	Occupationally exposed subjects studied, n	Allergic asthma cases due to mentioned agent, n, prevalence (%). Cases with probable allergic asthma but specific sensitization not confirmed in parentheses [] or not indicated.	EVIDENCE (pathological results)																								Remarks	
							WORK-RELATED SYMPTOMS												LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE		
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n sPFT	%	Reaction			n/n SPT	%	n/n IgE		%
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%	i					
			Nieuwenhuijsen, Heederik et al., 1999	2-; survey	264	[16]	16/256*	6.3	45/256	7.6	45/256	7.6	nd	nd	17/256	6.6	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	12/256*	4.7	nd		Workers at 3 bakeries, 3 flour mills and 1 packing station. *None of the asthmatics has sensitized; sign. exposure-reponse relationship between exposure and sensitization	
			Houba, Heederik et al., 1996	2-; cross-sectional	178	5 (2.8)	9/178	5.1	26/178	14.6	10/178	5.6	nd	nd	19/178	10.7	44/178	24.7	x*	nd	nd	nd	nd	nd	nd	nd	16/169	9	13/169	8	Bakers in 14 bakeries. *Individual results not listed; sign. association between alpha-amylase exposure levels and SPT+, and also between sensitization and WR respiratory symptoms; 5 asthmatics SPT+; see also bakery	
			Losada, Hinojosa et al., 1992	3+; survey	83	6	24/80	30.0	47/80	58.8	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	6/14*	42.9	6	nd	26/83	31.3	43/83	51.8	Pharmaceutical-industry workers. *SIC in SPT+ with respiratory symp, not all asthmatics underwent SIC; 1/5 oral Ch induced a 30% decrease in FEV1 (immediate)		
			Baur, Chen et al., 1994	3+; survey (screening)	89	.*	*	*	*	*	nd	nd	*	*	43/89	48.3	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	16/89	17.8	14/89	15.7	89 bakers partially selected due to symptoms or as part of a screening study. *43 had asthma, rhinitis, conj. and/or skin symptoms; 34/89 IgE+ to wheat and/or rye; sensitized asthmatics not listed	
			Brisman and Belin, 1991	3; case reports (index cases) with survey	4	3 (75)	3/4	75	4/4	100	nd	nd	nd	nd	4/4	62.5	nd	nd	nd	nd	nd	nd	nd	nd	nd	4/4	100	4/4	100	4 index cases of a factory producing semimanufactured products for bakeries		
			Moneo, Alday et al., 1995	3+; case series	25	7 (28)	25/25	100	nd	nd	nd	nd	nd	nd	25/25	100	nd	nd	nd	nd	nd	8/25	32	8	nd	11/25	44	6/25	24	Asthmatic bakers. 7/8 SIC+ were SPT+		
			Quiroce, Fernández-Nieto et al., 2002a	3; case reports	4	4	4/4		4/4	nd	nd	nd	nd	4/4		2/4	4/4	nd	nd	nd	3/3	2	1	1	4/4		4/4			3 bakers and 1 employee of an enzyme-processing plant. 2/4 SPT+ with hemicellulase; see glucoamylase		
			Valdivieso, Subiza et al., 1994	3; case reports	4	2 (50)	2/4	50	4/4	4/4	nd	nd	nd	4/4	100	0/4	0	1/4	25	nd	2/2*	2			4/4		4/4			Bakers. *SIC in asthmatics; 2/2 nasal Ch+		
			Bianco Carmona, Juste Picón et al., 1991	3; case report	1	1	1/1		1/1	1/1	nd	nd	nd	1/1		0/1	0/1	nd	nd	1/1	1			1/1		1/1		1/1			Baker	
			Birnbaum, Latil et al., 1988	3; case report	1	1	1/1		nd	nd	nd	nd	nd	1/1		nd	nd	nd	nd	1/1	1			1/1*		1/1*		1/1			Baker. *IC; also IC+ with flour; SIC- with flour	
Alpha-amylase inhibitors of cereal origin	-	3	López-Rico, Moneo et al., 1998	3; case reports	3	3	3/3		2/3	2/3	nd	nd	nd	3/3		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	x*		3/3**			Wood factory workers. *3/3 SPT+ with cereals; **IgE with 13 alpha-amylase families	
Amylase from <i>Bacillus licheniformis</i>	-	4	Hole, Draper et al., 2000	3; case reports	4	4	4/4		4/4	nd	nd	nd	4/4		nd	4/4	nd	nd	4/4	nd	4/4	1	1	2	4/4		4/4				Detergent industry workers	
Aspergillus enzymes	(*)		Quiroce, Cuevas et al., 1992	3+; case series	5		5/5		5/5	3/5	nd	nd	5/5		0/5	5/5	nd	nd	nd	nd	nd	nd	nd	nd	nd	5/5	4	1	5/5	5/5	Bakers. 4/5 SPT+ with wheat and with rye; 5/5 IgE+ with wheat; 4/5 SIC+ with wheat (3 immediate, 1 dual)	
Alpha-amylase from <i>A. oryzae</i>		5																														
Cellulase from <i>Aspergillus niger</i>		4																														
Aspergillus oryzae enzymes	-	1	Baur, 1981	3; case report	1	1	1/1		nd	nd	nd	nd	1/1		nd	nd	nd	nd	1/1*	1												Pharmaceutical worker. *SIC with a mix of <i>A. oryzae</i> enzymes (Protease, Amylase, Lipase)
Amylase from <i>Aspergillus oryzae</i>																																
Protease from <i>Aspergillus oryzae</i>																																
Beta-Glucanase and Phytase	-	1	O'Connor, Bourke et al., 2001	3; case report	1	1	1/1		nd	nd	1/1	nd	1/1		0/1	1/1	1/1	nd	1/1*	1						1/1*		1/1*			Director of an animal feed manufacturing plant. Other 22 employees asymptomatic. *SIC-, SPT+, and IgE+ with both phytase and beta-glucanase	
Bromelain of <i>Ananas comosus</i>	[*]	13	Gailhofer, Wilders-Truschnig et al., 1988	3+; cross-sectional with index cases	4	4	4/4		3/4	3/4	nd	nd	4/4		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	3/3		4/4			Workers of a blood grouping laboratory. All symptomatics IgE+; *SPT was done in 3 symptomatics; 2 developed anaphylactic reactions	
			Gailhofer, Teubl et al., 1987	3; case reports	2	2	2/2		1/2	1/2	nd	nd	2/2		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	2/2	100	2/2	100		Labor workers. SPT- and IgE- with papain	
			Galleghos and Rodriguez, 1978	3; case reports	2	2	2/2		2/2	1/2	nd	nd	2/2		0/1	nd	nd	nd	nd	2/2	1	1	2/2			nd					Pharmaceutical laboratory workers. 1 subject had asthmatic symptoms also after ingestion of pineapple	
			Baur and Fruhmman, 1979	3; case report	1	1	1/1		1/1	nd	nd	nd	1/1		nd	nd	nd	nd	1/1	1					1/1		1/1				Pharmaceutical worker	

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							WORK-RELATED SYMPTOMS														LFT		NSBHR		sPFT		SIC				SPT		Spec. IgE		
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n sPFT	%	Reaction				n/n SPT	%	n/n IgE	%			
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%	i	(n)					l	(n)	
Cellulase from <i>Trichoderma reesei</i>	(*)	7	Vanhänen, Tuomi et al., 2000	3; case series	11	7 (63.6)*	8/11		8/11	1/11		nd		5/11	11/11		0/11		7/11		nd		8/11	7	1	10/11		8/11		Employees in an enzyme factory. *7/8 SIC+ were SPT+; co-exposure to xylanase; 5/10 IgE+ and 7/10 SPT+ with xylanase					
Cellulase from <i>Trichoderma viride</i>	[*]	2	Ransom and Schuster, 1981	3+; cross-sectional with case report	11	2 (18.2)	2/11	18.2	3/11	27.2	nd	1/11	9.1	nd	3/11	27.2	0/1		nd		nd						1/1*		2/11	18.2	Experimental plant pathologists. Both asthmatics sensitized				
Cellulase	-	2	Tarvainen, Kanerva et al., 1991	3; case reports	4	2 (50)	3/4	75	2/4	50	3/4	75	3/4	75	4/4	100	0/4		2/3	66.6	2/4	50	nd				3/4	75	4/4	100	3 laboratory assistants and 1 process worker. 2 were co-exposed and co-sensitized to xylanase; see xylanase				
Cellulase from <i>Aspergillus niger</i>	-	2	Lozada, Hinojosa et al., 1986	3; case reports	2	2	2/2		2/2		1/2		2/2		2/2		nd		nd		nd		2/2	2		2/2		2/2		Pharmaceutical workers					
Cellulase from <i>Trichoderma viridae</i> and <i>Fusarium moniliform</i>	-	1	Kim, Nahm et al., 1999	3; case report	1	1	1/1		nd		nd		1/1		nd		nd		1/1		nd		1/1	1		1/1		1/1		Employee in the textile industry.					
Detergent enzyme protease	*[*]	55	Brant, Upchurch et al., 2009	2+; case-control study	884	[221 (25)]**	221/884*	25	214/884	25	nd		nd		nd		nd		nd		nd						nd		nd		Cohort of workers in a detergent factory between 1989 and 2002. Probably including cases from Cullinan et al., 2000, Brant et al., 2004 and 2006. *Incidence rates 1991-1995: x=5%; 1996-2001: x=11.6% and 2002: 4%. ** no information on specific sensitisation but clear relationship between exposure to detergent protease and reports of work related symptoms.				
Detergent enzymes (Protease, Amylase, Cellulase)			Brant, Zekveld et al., 2006	3+; Follow-up	35	25 (71.4)**	25/35	71.4	26/35	74.3	nd		nd		nd		nd		nd		nd						33/35*	94.3	34/35	97.1	Follow-up of 35 of 45 ex-employees from a factory with diagnosed occupational asthma. Probably including cases from Cullinan et al., 2000. *At date of diagnosis all 35 had SPT+. ** 25/35 continued to report respiratory symptoms and were still sensitized even if the magnitude of Spec. IgE at diagnosis or follow-up was not a prognostic feature for respiratory symptoms.				
Detergent enzymes			Cullinan, Harris et al., 2000	3+; survey	350	28 (8)**	54/342*	15.8	68/342*	19.9	nd		nd		nd		nd		nd		nd						90/342*	26.3			Employees in a factory using encapsulated detergent enzymes. *90 employees had SPT+ to at least one detergent enzyme. Indicated are work-related symptoms with enzyme sensitization. ** 42 workers requested				
Detergent enzymes			Adishes, Murphy et al., 2011 ABSTRACT	3; case reports	6	[2 (33.3)]	3/6	50	3/6	50	nd		nd		nd		nd		nd		nd						nd		nd		Health-care workers from three different work places. 2 cases of occupational asthma, the others indicated as having work-related rhinitis or asthma				
Detergent enzymes			Brant, Hole et al., 2004	3; case reports	3	3	3/3		3/3		2/3		2/3		nd		3/3		2/2		0/1		3/3				3	3/3	3/3		Detergent industry workers				
Cellulase from <i>Humicola insolens</i>					3																	1/1				1	2/3	1/2							
Lipase from <i>Aspergillus oryzae</i>					2																	2/2				1	2/2	2/2							
Enzyme powder: in cheese production, fungal and pancreatic-based	-	2	Casper, Zacharisen et al., 2008 ABSTRACT	3; case reports	2	2	2/2		1/2		nd		nd		nd		0/2		1/2		nd							2/2		nd	Workers exposed to airborne enzyme powders used in cheese production.				
Enzymes Alpha-amylase and Lysozyme	-	1	Santacalla, De Barrio et al., 2002	3; case report	1	1	1/1		1/1		1/1		nd		nd		0/1		nd		nd		1/1				1/1*		1/1*		Baker. * SPT+ and Spec. IgE+ to egg white, egg yolk, ovomucoid, wheat flour, barley flour, D. pteronyssinus, D. farinae, G. Fusca and L. destructor				
Enzymes	[*]	1	Vanhänen, Tuomi et al., 1997	3+; cross-sectional	173	1 (0.6)	1/21*		11/21*		2/21*		6/21*		1/21*		27/173	15.6	nd		nd							21/173**	12.1	16/173	9.3	Employees of a biotechnological plant and laboratory. *Individual WRS listed in SPT+ only; **SPT+ with at least 1 enzyme; sign. exposure-response relationship for sensitization and for respiratory symptoms			
Alpha-amylase (bacterial)																											2/21								
Alpha-amylase (fungal)																											5/21								
Cellulase																											14/21								
Phytase																											4/21								
Xylanase																											15/21								
Enzymes			Zentner, Jeep et al., 1997	3+; case series	20	4 (20)	4/20	20	3/20	15	1/20	5	3/20	15	nd		5/20	25	nd		nd		nd				10/20		10/20		Pharmaceutic factory workers: 10 SPT+ to at least one enzyme and 10 SPT- to enzymes				
Amylase from <i>A. oryzae</i>																											3/20		1/20						
Bromelain from <i>Ananas comosus</i>																											7/20		5/20						
Chymotrypsin from porcine pancreas																											8/20		5/20						
Lipase from <i>A. oryzae</i>																											3/20		1/20						
Papain from Papaya fruit																											9/20		9/20						
Trypsin from bovine pancreas																											8/20		6/20						
Flaviastase from <i>Aspergillus niger</i>	-	3	Pauwels, Devos et al., 1978	3; case reports	3	3	3/3		nd		nd		nd		3/3		nd		nd		nd		nd				nd		3/3		Pharmacy workers				
Glucosylase (amylglucosidase) from <i>Aspergillus niger</i>	-	4	Quirce, Fernández-Nieto et al., 2002a	3; case reports	4	4	4/4		4/4		nd		4/4		4/4		2/4	50	4/4	100	nd		3/3	3			4/4	100	4/4	100	3 bakers and 1 employee at an enzyme-processing plant. 2/4 SPT+ with hemicellulase				
Glucose oxidase from <i>Aspergillus niger</i>	-	1	Baur, 1981	3; case report	1	1	1/1		nd		nd		nd		1/1		nd		nd		nd		nd				1/1*		1/1		Pharmaceutical worker. *IC				
Lactase from <i>Aspergillus</i>	[*]	9	Muir, Verrall et al., 1997	3+; cross-sectional	207	9 (4.4)	20/207	9.7	33/207	15.9	18/207	8.7	nd		nd		nd		nd		nd		nd				65/207		31.4	nd	Employees in a lactase-packaging plant. 9 asthmatics sensitized				
Lysozyme (lysozyme chloride)	-	1	Park and Nahm, 1997	3; case report	1	1	1/1		1/1		nd		1/1		nd		nd		1/1		nd		1/1	1			1/1		1/1		Pharmaceutical industry worker. Co-exposure and co-sensitization to peptidase; see peptidase				

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							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE																					
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction			n/n SPT	%	n/n IgE	%																		
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%						i	(n)	d	(n)														
Porcine pancreatic extracts (PPE) composed of alpha-amylase and lipase	(*)	19	Park, Kim et al., 2002	3+; case series	4	4	4/4		1/4		nd		nd		nd		nd		nd		nd		nd		nd		nd		nd		nd		nd		nd		nd		nd		nd		nd		nd		nd		Nurses
Pancreatin (porcine), containing trypsin, amylase, lipase			Wiessmann and Baur, 1985	3+; case series	14	11 (78.5)	14/14	100	nd		nd		nd		14/14	100	11/14	78.5	7/7	100	nd		8/8	100	8																					Employees of pharmaceutical company. 3/6 asthmatics who did not undergo SIC had BHR+			
Pancreatin (porcine and bovine), containing trypsin, alpha-amylase			Baur, Wiefmann et al., 1984	3; case reports	4	3 (75)	4/4		nd		nd		2/4	50	nd		4/4		nd		nd		nd																					1 nurse, 3 pharmaceutical workers. Cross-reactivity between porcine and bovine Pancreatin					
Pancreatin (alpha-amylase of porcine pancreatin)			Aiken, Ward et al., 1997	3; case report	1	1	1/1		nd		nd		nd		1/1		0/1		1/1		nd		1/1																					Laboratory worker					
Papain of Carica papaya	**	109	Novoy, Keenan et al., 1980	2+; cross-sectional	23	8 (34.8)	12/23	52.2	20/23	87	17/23	73.9	9/23	39.1	20/23	87	23/23	100	x*		nd		nd		nd																				Pharmaceutical workers. *Sign. Raw increase and FEV1/FVC decline in the 17 tested; 8 asthmatics IgE+, 1 asthmatic not IgE tested				
			Baur and Fruhmann, 1979	2+; cross-sectional	11	5 (45.5)	5/11	45.5	7/11	63.6	1/11	9.1	6/11	54.6	nd		7/11	63.6	nd		nd		nd		5/5		4		1		7/11	63.6	7/11											9 kitchen workers and 2 pharmaceutical workers. All asthmatics sensitized; SIC in asthmatics only					
			Baur, König et al., 1982	3+; cross-sectional	33	12 (36.4)	15/33	45.5	15/33	45.5	5/33	15.2	nd		3/33	0.9	17/33	51.5	nd		nd		nd		8/9*		5		3		16/33	48.5	15/33											4 selected papain workers with respiratory symptoms and screening of other 29 papain workers ; *4 sensitized asthmatics did not undergo SIC					
			Vogelmeier, Baur et al., 1985	3+; cross-sectional	31	11 (35.5)	17/31	54.8	17/31	54.8	0/31		0/31		0/31		17/31	54.8	nd		nd		nd		nd																			Papain workers. 14/31(45.2%) IgG+. All IgE+ were symptomatic					
			Milne and Brand, 1975	3; case reports	4	2 (50)	2/4	50	3/4	75	1/4	25	2/4	50	nd		4/4	100	1/4	25	2/4	50	nd	nd																				Food technologists. *Both asthmatics scratch test+					
			Tarfo, Shaikh et al., 1978	3; case reports	2	1	1/2		2/2		2/2		1/2		1/2		2/2		0/2		1/2		nd		nd																		Laboratory technician and packaging plant worker						
			Marchioli, Sokol et al., 1977	3; case report	1	1	1/1		nd		nd		nd		1/1		nd		nd		nd		nd		1/1																			Meat tenderizer production worker. *IC					
			Merget, Bergmann et al., 1995	3; case report	1	1	1/1		1/1		1/1		nd		1/1		1/1		1/1		nd		nd		nd																			Grocer, not exposed for the last 8 years.					
			Quinones, Alonso et al., 1999 ABSTRACT	3; case report	1	1	1/1		1/1		1/1		nd		1/1		1/1		1/1		nd		1/1		nd																			Papain worker. Nasal Ch+					
			Soto-Mera, Lopez Rico et al., 2000	3; case report	2	2	2/2		2/2		nd		nd		2/2		nd		nd		nd		nd		nd																				Beauty workers.				
Pectinase from Aspergillus niger	-	2	Hartmann, Walter et al., 1983	3; case reports	2	2	2/2		1/2		nd		1/2		nd		2/2		nd		nd		nd		nd																					Employees (secretary and mechanic) of pectinase production. *Scratch test			
Pectinase from Aspergillus niger and glucanase from Trichoderma	-	3	Sen, Wiley et al., 1998	3; case reports	3	3	3/3		2/3		3/3		nd		3/3		nd		3/3*		nd		nd		nd																				Employees in fruit salad processing. *Serial PEFR at work and off-work for 2 weeks; **IgE with blend of pectinase and glucanase				
Pepsin (porcine)	-	3	Drexler and Beyer, 1997	3; case report	1	1	1/1		1/1		1/1		nd		1/1		1/1		1/1		nd		0/1		1/1																				Worker checking meat for trichina. Nasal Ch+ (immediate)				
			Anibarro Bausela and Fontela, 1996	3; case report	1	1	1/1		1/1		1/1		1/1		1/1		0/1		1/1		1/1*		1/1																					Cheese factory worker, co-exposure and co-sensitization to lysozyme. *PEFR for 5 days off-work and 1 day at work					
			Cartier, Malo et al., 1984b	3; case report	1	1	1/1		1/1		1/1		nd		1/1		0/1		1/1		1/1		1/1		1/1																			Employee in a pharmaceutical company with perennial asthma					
Peptidase from Serratia ssp.	-	1	Park and Nahm, 1997	3; case report	1	1	1/1		1/1		nd		1/1		nd		1/1		1/1		nd		1/1		nd																				Pharmaceutical worker. Co-exposure and co-sensitization to lysozyme chloride				
Phytase from Aspergillus niger	*[*]	12	Doekes, Kamminga et al., 1999	2+; cross-sectional	11	5 (45.5)	5/11	45.5	nd		nd		2/11	18.2	nd		6/11	54.5	nd		nd		nd		nd																				Workers in animal feed additives factory. Sign. elevated IgE of exposed compared to non-exposed subjects; SPT+ in 2 external and 3 internal controls				
			Baur, Melching-Kollmuss et al., 2002	2+; cross-sectional	53	7 (13.2)	12/53	22.6	35/53	66	16/53	30.2	nd		3/53	5.7	38/53	71.7	nd		nd		nd		3/53																				Employees in an animal husbandry. High-exposed sign. more frequently IgE+; 7 asthmatics sensitized (personal communication)				

Agents	Strength of evidence per agent (three star system of RCGP)	Total no. of allergic asthma cases per agent, n	Reference	Level of evidence per study (revised SIGN grading system); study type.	Occupationally exposed subjects studied, n	Allergic asthma cases due to mentioned agent, n, prevalence (%). Cases with probable allergic asthma but specific sensitization not confirmed in parentheses [] or not indicated.	EVIDENCE (pathological results)																								Remarks		
							WORK-RELATED SYMPTOMS												LFT		NSBHR		sPFT		SIC				SPT			Spec. IgE	
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total						Reaction										
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%	n/n LFT	%	n/n NSBHR	%	n/n PFT	%	n/n SIC	%	i	(n)	l	(n)		d	(n)
Proteolytic enzymes derived from <i>Bacillus</i> species	-	-	Cathcart, Nicholson et al., 1997	2-; survey with follow-up (4-20 years)	731	[166 (*)]	166/7*		nd		nd		nd		nd		nd		nd								nd		nd		INDUSTRY STUDY Surveillance of workers from 5 enzyme detergent factories over 4-20 years, follow-up of the 2 previous studies listed below. *166 confirmed cases of enzyme asthma between 1968-1992 within several thousand employees in 5 factories, 16 new cases since 1978; **sign, yearly fall in FEV1 and FVC in 731 subjects between different locations and by smoking habit and not by enzyme exposure, all subjects with respiratory symptoms were excluded from LFT analysis		
Various enzymes from <i>Bacillus subtilis</i>	**	327																															
Protease, Alcalase from <i>Bacillus subtilis</i> , proteolytic enzyme			Flood, Blofeld et al., 1985	2-; cross-sectional with follow-up (11 years)	2800	126 (4.5) incident cases	126/2800*	4.5	nd		nd		nd		nd		126/2800*	4.5	**		nd		nd		nd		nd		450/2713	16.6	nd	INDUSTRY STUDY Enzyme detergent workers in 3 UK factories, follow-up of the previous study listed below. *All figures given as incidence over a 11 year period (1969-1980); subjects with SPT+ and WR asthma or FEV1 fall owing to enzyme exposure; **mean annual FEV1 fall 39 ml in 2344 subjects	
Protease, Alcalase from <i>Bacillus subtilis</i> , proteolytic enzyme			Juniper, How et al., 1977	2-; cross-sectional with follow-up (7 years)	1642	[34 incident cases]	34/1642*	2.1	nd		nd		nd		nd		53/1642*	3.2	7/12	58.3	nd		nd		nd		nd		288/1642	17.5	**	INDUSTRY STUDY Enzyme detergent workers in UK. All figures given as incidence over a 7 year period (1968-1975); *34/53 symptomatics had new-onset respiratory symptoms and 19/34 had work-exacerbated asthma; **70% correlation between RAST and SPT for 350 subjects tested, individual results not listed; sensitized asthmatics not listed	
Protease, Alcalase from <i>Bacillus subtilis</i>			Pepys, Wells et al., 1973	2-; cross-sectional	65	11	nd		nd		nd		nd		nd		11/65		nd		nd		nd		nd		26/65		17/65		Enzyme factory workers. All 11 with "lung impairment" (no details listed) were SPT+		
Alcalase from <i>Bacillus subtilis</i>			Newhouse, Tagg et al., 1970	2-; cross-sectional	271	42	117/271	43.2	*		*		*		*		nd		11/271**	4.1	nd		***46		nd		57/271**	21	0/31		Enzyme detergent workers. *Individual data not listed; **6/11 LFT+ were sensitized; ***sign, decreased mean FEV1 cross-workshift in 15 sensitized asthmatics; ****42/57 SPT+ were asthmatic; 2. survey 6 mo. later		
			Slavin and Lewis, 1971	2-; cross-sectional	238	51 (21.4)*	61/238	25.6	31/238	13.0	nd		nd		nd		66/238	27.7	**		nd		nd		nd		114/238	47.9	nd		Detergent factory workers. *At least 51 asthmatics sensitized; **at least 40 symptomatics LFT+		
			Mitchell and Gandevia, 1971	3+; cross-sectional	98	28 (28.6)	49/98	50	62/98	63.3	+		7/98	7.1	nd		nd		*		**		nd		nd		51/80	63.8	nd		Workers of a detergent factory. *No sign. difference between symptomatics and asymptomatics; **results not listed; 28 asthmatics SPT+, 10 asthmatics not SPT tested		
Proteases from <i>Bacillus subtilis</i>			Greenberg, Milne et al., 1970	2-; cross-sectional	121	21 (17.4)	28/121	23.1	77/121	63.6	77/121	63.6	19/121	15.7	nd		89/121	73.6	31/121	25.6	nd		nd		nd		48/121	39.7	nd		Detergent factory workers. 21/31 obstructive subjects SPT+		
Alcalase																											42/121	34.7					
Maxatase																											36/121	29.8					
Proteinase																											42/121	34.7					
Protease, Esperase from <i>Bacillus subtilis</i>			Zachariae, Hoegh Thomsen et al., 1981	2-; survey with 10 year follow-up	667	16 [0.24]	16/667	2.4**	6/667	0.9**	nd		2/667	0.3*	nd		22/667*	3.3**	nd		nd		nd		nd		nd		31/667	4.7**		Detergent enzyme production workers. Co-exposure and co-sensitization (70/667 IgE+) to Alcalase from Subtilisin-A; *WRS given in sensitized subjects only; all symptomatics IgE+; **incidence in 10 years	
Proteases from <i>Bacillus subtilis</i> : Maxapem and Esperase; cellulase, alpha-amylase, lipase			Vanhnen, Tuomi et al., 2000	3+, cross-sectional	40	1 (2.5)	1/40	2.5	19/40	47.5	2/40	5	5/40	12.5	2/40	5	19/40	47.5	nd		nd		nd		1/1*		9/40	22.5	9/9**		Detergent factory workers. *SIC+ with protease, type of reaction not listed; **IgE done in SPT+ subjects; 1 asthmatic subject SPT+; 6/7 nasal Ch+		
Proteolytic enzymes derived from <i>Bacillus</i> species (Esperase)			Liss, Kominsky et al., 1984	2-; cross-sectional	15	1 (6.7)	+	+	+	+	+		nd		6/15*	40	x**		nd		x***		nd		nd		nd		3/14****	21.4	Detergent workers. 13 currently and 2 previously exposed. *Eye, nose, throat or chest WRS; **no difference between exposed and nonexposed; ***sign		
Enzymes of <i>Bacillus subtilis</i> (Alcalase and Maxatase)			Pepys, Hargreave et al., 1969	3; case reports	3	3	3/3		1/3		0/3		3/3		0/3		3/3		3/3		nd		nd		3/3*		3	3/3**		nd		Enzyme workers. *SIC done with Alcalase; **SPT done with Alcalase and Maxatase	

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							WORK-RELATED SYMPTOMS														LFT		NSBHR		sPFT		SIC				SPT		Spec. IgE		
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction				n/n SPT	%	n/n IgE	%			
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%	i	n					l	d	
Subtilisin from <i>Bacillus subtilis</i>			Franz, McMurray et al., 1971	3; case series	38	22 (57.9)	25/38	65.8	11/38	28.9	nd	nd	nd	2/38	5.3	38/38	100	3/28	10.7	nd	nd	nd	9/10	90	4	5	25/38*	65.8	nd	Employees of enzyme detergent producing plant; *IC; 22/25 asthmatics SPT+					
Maxatase of <i>B. subtilis</i>			Dijkman, Borghans et al., 1973	3+; case series	6	5 (83.3)	3/6	50	4/6	66.6	nd	5/6	83.3	nd	6/6	100	1/6	16.6	5/6	83.3	nd	6/6	100	1	5	5/6	83.3	nd	Workers of a detergent factory						
Proteolytic enzymes: Alcalase	(*)	6	Paggiaro, Pardi et al., 1984 ABSTRACT	3+; case series	6	5-6	6/6		nd	nd	nd	nd	nd	6/6		3/6		4/6		2/6		6/6					5/6	+	Enzyme workers						
Protease, Pronase E from <i>Streptomyces griseus</i>	-	1	Kempf, Oman et al., 1999	3; case report	1	1	1/1		nd	nd	nd	nd	1/1		1/1		1/1		nd	nd	nd						1/1		1/1	Medical laboratory technician					
Rennet, not specified	-	1	Jensen, Dahl et al., 2006	3+; cross-sectional	35	[6 (17.1)]*	6/35	17.1	1/35	2.9	nd	nd	9/35	25.7	12/35*	34.3	0/35	0	nd	nd	nd						14/35*	40	nd	Workers in a rennet producing plant. *SPT + to one or more rennets. 6/14 workers with SPT+ had respiratory symptoms. Not indicated if these were asthma symptoms					
Rennet of <i>Endothia parasitica</i> , Suparen®			Ninimäki and Saari, 1978	3; case report	1	1	1/1		nd	nd	nd	nd	1/1		nd		nd		nd	nd	nd						1/1*		nd	Cheesemaker. *Scratch test; additional 7 cheesemakers exposed but not sensitized, 5 of them had WRS					
Trypsin (porcine), inactivated	*	4	Colten, Polakoff et al., 1975	2+; cross-sectional	14	4 (28.6)	4/14	28.6	1/14	7.1	1/14	7.1	2/14	14.3	nd	4/14	28.6	1/4		nd	nd	3/3**	100	3		4/14*	28.6	nd	Workers at the plastics plant. *Scratch-test; **SIC in 3 asthmatics only						
Xylanase from <i>Aspergillus niger</i>	-	3	Baur, Sander et al., 1998	3; case report	1	1	1/1		1/1		1/1		1/1		nd	1/1		1/1		nd	nd	1/1		1		1/1		1/1	1/1	Baker. Also SPT+, IgE+ with cellulase of <i>A. niger</i> , alpha-amylase of <i>A. oryzae</i> and wheat flour					
			Tarvainen, Kanerva et al., 1991	3; case reports	2	2	2/2		1/2		2/2		2/2		2/2		0/2		2/2		1/2		nd			2/2	100	2/2	100	Laboratory assistants. Co-exposure and co-sensitization to cellulase; see cellulase					
Various enzymes	-	-	Baur, Sauer et al., 1988	3+; case series	140	*	*	*	*		nd	nd	140/140		nd		nd		nd	nd	nd	13/20**	8	5		nd		nd		*Bakers with WR-asthma, rhinitis and/or conjunctivitis with no signs of sensitization to flour. **SIC done in sensitized workers					
Alpha-amylase from <i>A. oryzae</i>																																			
Glucosylase from <i>A. niger</i>																																			
Hemicellulase from <i>A. niger</i>																																			
Papain (<i>C. papaya</i>)																																			
Protease from <i>B. subtilis</i>																																			
Soybean																																			
Low-molecular-weight compounds																																			
CHEMICALS																																			
DRUGS																																			
Aescin	-	1	Munoz, Culebras et al., 2006	3; case report	1	[1]	1/1		1/1		nd	1/1		nd	nd		0/1		1/1		1/1						nd	nd	nd	Employer in the pharmaceutical industry. Sensitisation to <i>Plantago ovata</i> was also tested. SIC and SPT were positive					
Alpha-methylidopa	-	1	Harnies, Newman Taylor et al., 1979	3; case report	1	1	1/1		1/1		nd	nd	1/1		nd	1/1		0/1		1/1		1/1		1	1		0/1		nd	Chemist in a drug factory					
Aminophylline	-	1	Rosenberg, Aaronson et al., 1984	3; case reports	2	1 (50)	2/2		2/2		nd	1/2		2/2		0/2		nd		nd		2/2		2		1/2*		nd		Pharmaceutical workers. *IC					
Amprolium hydrochloride	-	1	Greene and Freedman, 1976	3; case report	1	[1]	1/1		1/1		nd	nd	1/1		1/1		0/1		nd		nd	1/1		1			nd		nd	Chemical industry worker mixing poultry feed					
Cephalosporine	[*]	8																																	
7-aminocephalosporanic acid (7-ACA)			Briatico-Vangosa, Beretta et al., 1981	3+; cross-sectional	91	5 (5.5)	7/91	7.7	nd	nd	nd	11/91	12.1	18/91	20	nd		nd		nd		nd					13/91	14.3	nd	Workers in cephalosporine production. 5/7 asthmatics were SPT+					
Cephalosporin intermediate (7-ACA, 7-aminocephalosporanic acid)			Park, Kim et al., 2004	3+; case series	5	1 (20)	2/5	40	1/5	20	nd	nd	2/5	40	nd		2/2	100	nd		2/2	100	2			1/5	20	2/5	40	Pharmaceutical plant workers. 1 asthmatic was SIC+ and sensitized					
Cephalosporins			Coutts, Dally et al., 1981	3+; case reports	2	2	2/2		1/2		nd	1/2		2/2		nd		nd		nd		2/2		2		2/2		nd		Cephalosporin production worker exposed to 7ACA and 7CTD and chemist exposed to cephalixin					
7-aminocephalosporanic acid (7ACA)																						1/1		1		1/1									
Tosylate dihydrate derivative of Cephalixin																						1/1		1		1/1									
Cephalosporin (Cefadroxil)			Sastre, Quirce et al., 1999	3; case report	1	[1]	1/1		1/1		nd	1/1		1/1		0/1		0/1		nd		1/1		1			0/1*		0/1*	Pharmaceutical worker. *IgE- with β-lactam antibiotics; oral Ch with cephalixin induced 22% decline in FEV1 (immediate)					

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							WORK-RELATED SYMPTOMS												LFT		NSBHR		sPFT		SIC				SPT			Spec. IgE	
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction				n/n SPT	%		n/n IgE	%
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%	i	(n)					
Cephalosporin (Ceftazidime)			Stenton, Dennis et al., 1995	3; case report	1	[1]	1/1		1/1		nd	nd	nd	1/1		0/1		1/1		nd		1/1	1*	1*		nd		nd	Ceftazidime packaging worker. *SIC done twice, a week apart				
Cefmetazole and 7-aminocephalosporanic acid			Fracchia, Paita et al., 1996 ABSTRACT	3; case report	1	[1]	1/1		nd		nd	nd	nd		nd		1/1		nd		1/1				0/1		0/1	Cefalosporin manufacture worker					
Chlorhexidine	-	-	Waclawski, McAlpine et al., 1989	3+; case reports	2	[2]	2/2		nd		1/2	nd	2/2		0/2		0/2		1/1		1/2*	1			nd		nd	Nursing auxiliary and midwife. *1. subject had 13% decline in FEV1 as positive reaction listed and 2. subjects had 22% decline in FEV1					
Cimetidine	-	-	Coutts, Lozewicz et al., 1984	3+; survey with index cases	4	-	-	-	nd		nd	nd	4/4		nd		1/3		nd		1/4	1			nd		nd	Index cases of cimetidin manufacture workers. *Respiratory symptoms; 1 SIC+ subject was NSBHR-; 2/4 nasal Ch+ (late)					
					55	[8 (14.5)]	8/55	14.5	20/55	36.4	nd	nd	nd	20/55	36.4	*	nd		nd		nd				0/55	0	nd	Cimetidin manufacture workers. 7/8 asthmatic were in daily exposure group; *lower FEV1 and sign. lower FVC in asthmatics					
Ciprofloxacin	-	1	Broding, Chen et al., 1996	3; case reports	2	1	1/1		1/1		nd	nd	1/1		0/1		0/1		nd		1/1	1			1/1		0/1	Workers in the Ciprofloxacin-production					
Fluochinolol acid	-						1/1		1/1		nd	nd	1/1		0/1		1/1		nd		1/1	1			0/1		0/1						
Hydralazine	-	-	Perrin, Malo et al., 1990	3; case report	1	[1]	1/1		1/1		nd	nd	1/1		nd		1/1		nd		1/1	1			0/1		0/1	Pharmaceutical worker with previous physician diagnosed asthma					
Isonicotinic acid hydrazide (INH)	-	1	Asai, Shimoda et al., 1987	3; case report	1	1	1/1		1/1		nd	nd	1/1		nd		1/1		1/1		1/1	1		1/1*		1/1**	Pharmacist. *SPT+ with INH-BSA and IC+ with INH and INH-HSA; **PK+						
Lasamide (Immediate of Furosemide)	-	-	Klusáková, Lebedová et al., 2007	3+; case series with follow-up	5	[3 (60)]	5/5	100	5/5	100	2/5	40	4/5	80	nd	5/5	100	0/5	0	3/5	60	nd	3/5*	60	2	1	nd	Lasamide production line workers. *3/5 SIC+ and 4/5 nasal Ch+ with 2,4-dichloro-5-chlorosulfonylbenzoic acid; all patients symptomatic 1-3 yrs after removal from exposure					
Mitoxantrone	-	-	Walusiak, Wittczak et al., 2002	3; case report	1	[1]	1/1		1/1		nd	1/1	nd	1/1		nd		1/1		nd		1/1	1		nd		nd	Nurse					
Opiate	*[*]	28																															
Opiate compounds			Biagini, Bernstein et al., 1992	2+; cross-sectional with follow-up	39	21 (53.8)	21/39*	53.8	22/39	56.4	22/39	56.4	15/39	38.5	16/39	41	nd	nd	nd	x**	31.3	nd				5-33/33***	15-100	x***	Ethic narcotics manufacture workers. *10/21 asthmatics had previous phys. diagn. asthma, 8 of them new-onset; **no sign. reduction in PEFR during workweek compared to 3 day nonwork; ***sign. lower epicutaneous threshold concentrations in exposed; ****no evidence of specific IgE				
M-6-HS-HSA																																	
Dihydrocodeine																																	
Oxycodone																																	
Hydrocodone																																	
Codeine																																	
Morphine																																	
Opium alkaloids, poppy (<i>Papaver somniferum</i>)			Moneo, Alday et al., 1993	3+; cross-sectional	28	6 (21.4)	6/28	21.4	nd		nd	nd	nd	6/28	21.4	nd	nd	nd	nd	nd	4/4*	4			6/28	21.4	6/28	21.4	Workers of pharmaceutical factory. 6/6 asthmatics sensitized; *SIC done only in asthmatics				
Opium compounds			Agius, 1990	3+; survey ABSTRACT	112	[4 (3.6)]	4/112	3.6	8/112	7.1	nd	nd	nd	19/112	17.0	nd	nd	nd	nd	nd	nd					nd		nd	Pharmaceutical workers. See index case Agius 1989				
Opium alkaloids (Codeine)			Romaguera and Grimalt, 1983	3+; case series	5	0	0/5		3/5		3/5	3/5	5/5	5/5	nd	nd	nd	nd	nd	nd	nd				3/5*		nd	Opium alkaloids workers. *3/5 Patch test+ with mixed opium alkaloids and codeine					
Opium alkaloids (<i>Papaver somniferum</i>)			Condé-Salazar, Guimaraens et al., 1991	3; case reports	2	1	1/2*		1/2		nd	1/2	2/2	2/2	nd	nd	nd	nd	nd	nd	nd				2/2**		nd	Opium alkaloids producing factory workers. *Cough and "respiratory difficulty"; **patch test					
Opiate compounds (Morphine)			Ullinski, Palczynski et al., 1996	3; case report	1	[1]	1/1		1/1		1/1	1/1	nd	1/1	0/1	1/1	1/1	1/1*		1/1	1				nd		nd	Pharmaceutical plant worker. *PEFR for 6 days off-work and 6 days at work; BD+; nasal Ch+ (late)					
*			Agius, 1989	3; case report	1	[1]	1/1		1/1		nd	nd	nd	1/1	1/1	1/1	nd	nd	nd	nd	nd					nd		nd	Pharmaceutical industry worker				
Penicilline	*[*]	4																															
Penicillin			Shmunes, Taylor et al., 1976	3+; cross-sectional	169	[2 (1.2)]	2/169	1.2	27/169	16.0	14/169	8.3	nd	37/169	21.9	67/169	39.6	nd	nd	nd	nd					1/169*	0.06	nd	Penicillin factory workers. *1/169 IC+ with benzyl penicilloyl-polylysine, 5/169 IC ambiguous responses				
Penicillin (ampicillin, pivampicillin, pivmecillinam, benzyl penicillin)			Møller, Nielsen et al., 1986	3+; case series	45	[5 (11.1)]	5/45	11.1	17/45	37.7	17/45	37.7	nd	45/45	100	45/45	100	nd	nd	nd	nd					45/45*	100	nd	Workers producing semi-synthetic beta-lactam antibiotics. *Patch test+ with at least one penicilline (on 2. and 3. day)				

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							WORK-RELATED SYMPTOMS														LFT		NSBHR		sPFT		SIC				SPT		Spec. IgE				
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction				n/n SPT	%	n/n IgE	%					
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%	i	(n)					l	(n)		d	(n)
Azidocillin, bacampicillin, benzylpenicillin			Stejskal, Forstbeck et al., 1987	3+; case series	8	[1 (12.5)]	1/8	12.5	2/8	25	nd	nd	nd	6/8	75	8/8	100	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	5/8*	62.5	nd	nd	Employees of a antibiotics plant. *Patch test	
Penicillin derivate			Davies, Hendrick et al., 1974	3+; case reports	4	[4]	4/4		3/4		1/4		2/4		2/4		4/4		2/4	50	nd	nd	nd	3/4	75	3		3		0/4		nd	nd	nd	Workers of a penicillin antibiotics producing factory. 1/2 oral Ch with ampicillin induced 36% decline in FEV1 (late); 1/1 oral Ch with benzyl penicillin induced 59% decline in FEV1 (late)		
Ampicillin																							2/3		2		2										
6APA (6-amino penicillamic acid)																																					
Benzyl penicillin																																					
Amoxicillin			Jiménez, Antón et al., 1998	3; case report	1	1	1/1		1/1		nd		1/1		nd		1/1		0/1		1/1		nd	1/1		1		0/1		1/1		1/1		1/1	Pharmaceutic laboratory worker. IgE- to ampicillin and penicillin V; SIC- to penicillin V; oral Ch induced 33% decline in FEV1 (late)		
Ampicillin			Vandenplas, Delwiche et al., 1997	3; case report	1	1	1/1		1/1		nd		1/1		nd		1/1		1/1		nd		1/1		1		nd		nd		nd		nd	nd	Pharmaceutical worker, co-exposed to latex. SPT+, IgE+ and SIC+(dual) with latex		
Ampicillin			Wüthrich and Hartmann, 1982	3; case report	1	1	1/1		1/1		nd		1/1		1/1		1/1		nd		nd		1/1		1		0/1		1/1*		1/1*		1/1*		Employee of an antibiotic-producing factory. *IgE+ with benzyl-penicilloyl		
Penicillamine			Lagier, Cartier et al., 1989	3; case report	1	[1]	1/1		1/1		nd		nd		nd		1/1		1/1		1/1		nd	1/1		1		0/1		0/1		0/1		0/1		Pharmaceutical worker	
Piperacillin sodium (Acylaminopenicillin)			Moscato, Galdi et al., 1995	3; case report	1	1	1/1		1/1		nd		nd		1/1		1/1		0/1		0/1		nd	1/1		1		1/1		1/1		1/1		1/1		Pharmaceutical worker	
Phenylglycine acid chloride (side chain of Ampicillin, Cephalexin, cephaloglycin)	[*]	4	Kammermeyer and Mathews, 1973	3+; cross-sectional	24	4 (16.7)	6/24*	25	nd	nd	nd	nd	7/24	29.2	10/24**		nd		nd		nd		2/2		2		9/24	37.5	3/3***					Industrial plant workers. *Wheezing, 4/6 SPT+; ***abnormal pulmonary function", individual parameters not listed; **3/3 symptomatics PK-Test+; all symptomatics were SPT+			
Salbutamol base	-	-	Agus, Davison et al., 1994	3; case reports	2	[2]	2/2		1/2		nd		1/2		nd		2/2		nd		nd		2/2*		1		0/1		nd		nd		nd		nd	Pharmaceutical process workers. *Serial PEFR at work and off work for 3-4 weeks	
Salbutamol intermediate - glycol compound powder: 2-(N-Benzyl-N-tert-butylamino)-4'-hydroxy-3'-hydroxymethylacetophenone diacetate	-	-	Fawcett, Pepys et al., 1976	3; case report	1	[1]	1/1		nd		nd		nd		1/1		1/1		1/1		1/1		nd	1/1		1		0/1		nd		nd		nd	Salbutamol production worker. Approx. 18 workers were exposed, one other had symptoms but was not tested		
Spiramycin	-	2	Malo and Cartier, 1988	3+; survey	51	[4 (7.8)]***	9/48	18.8	15/48	31.3	nd	nd	nd	nd	nd	3/48	6.3	6/43	14.0	0/48		3/12*	25	2		1		**		nd		nd		nd	All 51 employees of a pharmaceutical company. Symptoms and test results in the table reflect the production period during 2. and 3. assessments; *SIC done in BHR+ and/or subjects with 2.5 fold NSBHR change and/or asthmatics; **SPT results not interpretable; ***4 OA cases include 1 previously		
Spiramycin adipate (Spiramycin base + adipic acid)			Moscato, Naldi et al., 1984	3; case reports	2	[2]	2/2		1/2		nd		2/2		nd		2/2		2/2		2/2		2/2		2		0/2*		nd		nd		nd		Pharmaceutical workers. *Patch-test		
Spiramycin base																						1/1		1													
Adipic acid																						1/2		1													
Spiramycin			Paggiaro, Loi et al., 1979	3; case report	1	1	1/1		nd		nd		1/1		1/1		nd		nd		nd		1/1		1		1/1*		nd		nd		nd		nd	Chick breeder. *SPT+ and patch test+ (both late reaction)	
Spiramycin			Davies and Pepys, 1975	3; case report	1	1	1/1		1/1		nd		1/1		1/1		0/1		nd		nd		1/1		1		1/1		nd		nd		nd		nd	Engineer at the pharmaceutical industry	
Tetracycline	-	1	Menon and Das, 1977	3; case report	1	1	1/1		nd		nd		1/1		1/1		0/1		nd		nd		1/1*		1		1/1**		nd		nd		nd		nd	Mechanic in a pharmaceutical company. *FEV1 decline >20% after SIC, IC and oral Ch; **IC	
Thiamine	-	2	Drought, Francis et al., 2005	3; case reports	2	2	2/2		0/2		0/2		1/2		0/2		2/2		1/2		1/1		1/1		2/2		2		nd		0/1		0/1		0/1	Workers at breakfast cereal production plant	
Tylosin tartrate	-	1	Lee, Wang et al., 1989	3; case report	1	1	1/1		1/1		nd		1/1		1/1		1/1		1/1		1/1		nd	1/1		1		nd		nd		nd		nd		Worker in a pharmaceutical factory	
Polymyxin E (Colistin)	-	-	Gómez-Ollés, Madrid-San Martín et al., 2010	3; case report	1	[1]	1/1		1/1		nd		1/1		nd		0/1		1/1*		nd		1/1		1		nd		nd		nd		nd		nd	Worker in a pharmaceutical factory, co-exposure to other substances. Methacholine concentration of 16 mg/mL was required to produce a 20% decrease in FEV1	
METALS																																					
Aluminium	-	1	Simonsson, Sjöberg et al., 1985 ABCTRACT	3+; case-series with follow-up	19	[17 (89.5)]	19/19	100	nd	nd	nd	nd	nd	nd	0/19	0	17/19	89.5	nd		nd		nd		nd		nd		nd		nd		nd		nd	Workers exposed to inhaled particles of aluminium fluoride or sulphate at 2 plants. 11/15 still had NSBHR+ in follow ups 2-5 years after and an average of 41 months of non-exposure.	
			Vandenplas, Delwiche et al., 1998	3; case report	1	1	1/1		1/1*		nd		nd		nd		0/1		1/1		nd		1/1		1		0/1		0/1		0/1		0/1		0/1	Maintenance worker in a leather plant. *Allergic rhinitis since childhood.	

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							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE				
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction			n/n SPT	%	n/n IgE	%	
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%						i
Chromium	■	5	Park, Yu et al., 1994	3; case reports	4	4	4/4		2/4		nd		nd	1/4	nd	nd	nd	3%	2/2	4/4	3	1	2/4*	nd	nd	2 employed in metalplanting factories, 1 in a cement factory, 1 in the construction industry. *SPT- subjects had a positive patch test						
*			Leroyer, Dewitte et al., 1998	3; case report	1	1	1/1		1/1		nd		'1/1	nd	nd	0/1		*	nd	1/1	1		**	nd	nd	Roofer. *NSBHR increased after SIC. **Skin patch test positive.						
Chromium and Nickel	(*)	13	Novoy, Habib et al., 1983	3; case report	1	1	1/1		nd		nd		'1/1	nd	nd	1/1		nd	nd	1/1	1		0/1	1/1	nd	Electroplater						
*			Bright, Burge et al., 1997	3; case series	7	7*	7/7		nd		nd		nd	nd	nd	4/7		nd	2/4	Ch:7/7 Ni:2/5	3	2	2	Ch: 2/7 Ni: 2/7	nd	nd	Electroplaters. *7 have chrome-induced asthma, 2 of them also have a significant reaction to nickel. 1 worker developed acute asthma after high exposure to chrome.					
*			Jesus Cruz, Costa et al., 2006	3; case report	1	1	1/1		nd		nd		nd	nd	nd	0/1		0/1	nd	1/1*			1	1/1*	nd	Worker in a metalworks company. SPT+ to nickel only. SIC+ with late response to nickel and immediate response to chromium.						
*			Fernandez-Nieto, Quirce et al., 2006	3; case reports	4	4	4/4		nd		nd		nd	nd	nd	0/4		4/4	nd	Ch:4/4 Ni:2/4	1	2	1	1	Ch: 2/4 Ni:2/4	1/4	2 from an electroplating factory, 1 worker from a cement factory, 1 manual metal-arc welder. 1 patient had been included in a previous report (Sastre et al. 2001).					
Chromate	■	-	De Raeve, Vandecasteele et al., 1998	3; case report	1	[1]	1/1		nd		nd		1/1	1/1	nd	0/1		1/1	1/1	1/1		1		nd	nd	Cement floorer.						
Cobalt	■	2	Gheysens, Auwerx e al., 1985	3; case reports	3	[3]	3/3		3/3		nd		nd	nd	nd	1/3		3/3	2/2	3/3		3		nd	nd	Diamond polisher.						
*			Wittczak, Walusiak et al., 2003	3; case report	1	1	1/1		nd		nd		1/1	nd	nd	nd		nd	nd	1/1		1		0/1	nd	Dental technician.						
*			Krakowiak, Dudek et al., 2005	3; case report	1	1	1/1		'1/1		nd		1/1	nd	nd	nd		nd	nd	nd				1/1	*	Diamond polishing disc former. *Nasal provocation with cobalt chloride caused a significant increase in the proportion of eosinophils, basophils and albumin and a positive lymphocyte transformation.						
Cobalt and nickel	■	-	Shirakawa, Kusaka et al., 1990	3; case series	8	[6 (75)]	8/8	100	nd		nd		nd	nd	nd	7/8	87.5	8/8	100	nd	Co:8/8 Ni:7/8	100	3	3	2	6/8 5/8	75	5/8 4/8	62.5	50	Workers in a hard metal plant diagnosed as having occupational asthma. Cross-reactivity between nickel and cobalt is possible.	
Iron	■	-	Muñoz, Cruz et al., 2009	3; case reports	3	[3]	3/3		nd		nd		nd	nd	nd	0/3		3/3	nd	3/3		2		1	nd	nd	nd	Welders of iron.				
Manganese	■	-	Wittczak, Dudek et al., 2008	3; case report	1	[1]	1/1		nd		nd		nd	nd	nd	1/1*		1/1	1/1	1/1			1		0/1	**	Welder. *FEV1 decreased from 3.55 l (85% predictive values) to 2.54 l (57%), FVC from 4.34 l (80%) to 5.98 l (115%). **Increase in the proportion of eosinophils and basophils in induced sputum after manganese chloride challenge.					
Nickel sulfate	■	2	Malo, Cartier et al., 1982	3; case report	1	1	1/1		nd		nd		'1/1	nd	nd	0/1		1/1	1/1	1/1		1			1/1	1/1	nd	Worker in a metal-plating factory.				
*			Block, Yeung et al., 1982	3; case report	1	1	1/1		nd		nd		'1/1	nd	nd	1/1		1/1	nd	1/1		1			1/1	*	Metal polisher. SIC+ to work-dust and isolated nickel sulfate. Sensitization to chromium is possible. *No evidence of IgG or IgM antibodies by hemagglutination studies or gel diffusion.					
Soft corrosive soldering fluxes: Zinc chloride and ammonium chloride	■	-	Weir, Robertson et al., 1989	3; case reports	2	[2]	2/2		nd		nd		nd	nd	nd	2/2		2/2	2/2	2/2*		2			nd	nd	nd	1 worker making tins, 1 worker repairing car radiators. *First case had greater fall in FEV1 in SIC with the flux than in SIC with ammonium chloride. SIC with zinc chloride alone produced no fall. SIC in the second case was only performed with the flux.				
Platinum salts	**	96	Niezborala, Garnier et al., 1996	2+; prospective cohort study	77	10 (13)	10/77	13	15/77	19.5	nd		nd	7/77	9.1	nd		nd	nd	nd					18/77	23.4	nd	Workers in a refinery hired between 1979 and 1991. Follow-up with SPT every six months.				

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							WORK-RELATED SYMPTOMS														LFT		NSBHR		sPFT		SIC				SPT		Spec. IgE				
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction				n/n SPT	%	n/n IgE	%					
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%	i	n					l	n		d	n
			Venables, Dally et al., 1989	2+; prospective cohort study	91	21 (23.1)	21/91	23.1	nd	nd	nd	nd	nd	2/91	2.2	49/91	53.8	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	91 workers of a platinum refinery who started work between 1973 and 1974 with follow-up every 3-6 months until 1980. Smoking was the only significant predictor of SPT+ with platinum salts.
			Cristaudo, Sera et al., 2005	2-; cross-sectional	153	10 (6.5)*	10/22*	45.5	1/22*	4.5	nd	nd	nd	6/22*	27.3	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Workers in a catalyst production plant. SPT with different platinum salts. *Work-related symptoms of the sensitized workers.	
			Bolm-Audorff, Bienfait et al., 1992	2-; cross-sectional	65	9 (13.8)	16/65	24.6	14/65	21.5	6/65	9.2	nd	nd	nd	15/65	23.1	0/65	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	*	Workers in the chemical industry with exposure to platinum salts. *Higher total IgE and Spec.IgE in employees with work-related symptoms.		
			Merget, Schultze-Werringhaus et al., 1991	2-; cross-sectional	35	31 (88.6)*	35/35	100	32/35	91	24/35	68.5	nd	16/35	46	nd	5/35***	14.3	24/27**	88.8	nd	nd	22/27	81.5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Workers from two platinum refineries with work related symptoms seen between 1983 and 1990. *31 showed either SPT+ or SIC+. **8 were not submitted to SIC for medical or technical reasons. ***5 with FEV1/C < 65%, rest not indicated.	
			Pepys, Pickering et al., 1972	2-; cross-sectional	16	8 (50)*	16/16	100	nd	nd	nd	nd	nd	nd	nd	nd	5/16**	31.25	nd	nd	nd	8/16	50	7	1	10/16	62.5	nd	nd	nd	nd	nd	nd	nd	Worker in a platinum refinery. *8 workers had SPT+ and SIC+. **5 workers with slight airways obstruction.		
			Merget, Schultze-Werringhaus et al., 1988	3+; cross-sectional	30	7 (23.3)	8/30	26.6	8/30	26.6	7/30	23.3	nd	4/30	13.3	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	6 former and 27 actual workers in a platinum refinery. The symptomatic group had a higher exposure to platinum salts. doubtful work-related symptoms were not included.		
			Hunter, Milton et al., 1945	3+; cross-sectional	91*	[52 (57.1)]*	52/114*	45.6	nd	nd	nd	nd	nd	13/114*	11.4	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	114 Workers in four refineries, *91 exposed to platinum salts. **SPT was performed in half the workers of one refinery, the rest refused or the test was unsatisfactory.	
Palladium	■	1	Daenen, Rogiers et al., 1999	3; case report	1	1	1/1		1/1	1/1	nd	nd	nd	nd	nd	0/1	1/1*	nd	nd	nd	1/1	1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Worker exposed to nickel, tin, palladium, lead and gold. Isolated sensitization to palladium. *moderate NSBHR.		
Stainless steel welding fumes	■	-	Hannu, Pipari et al., 2007	3+; survey	34	[32 (94.1)]*	28/35*	80	nd	nd	nd	nd	nd	nd	nd	3/34	8.8	6/34	17.6	5/9	nd	32/34	94.1	9	16	9	0/24	0	nd	nd	nd	nd	nd	nd	nd	Welders diagnosed with asthma symptoms during the years 1994-2003. Follow-up after 6 months, 6 welders could continue with welding work. *28 were diagnosed with OA before the survey. 32 had SIC+.	
Vanadium	■	-	Musk and Tees 1982 ABSTRACT	3; case report	4	[4]	4/4		nd	nd	nd	nd	nd	nd	nd	nd	2/4	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Workers from a vanadium pentoxide refinery.	
Zinc	■	1	Malo and Cartier, 1987	3; case reports	2	[2]	2/2		nd	nd	nd	nd	nd	nd	nd	2/2	2/2	nd	nd	nd	2/2	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Solderers processing galvanized metal. One also showed fever and leukocytosis which suggests the presence of metal fume fever or hypersensitivity pneumonitis.	
			Malo, Cartier et al., 1993 ABSTRACT	3; case report	1	1	1/1		nd	nd	nd	nd	nd	nd	nd	0/1	1/1	1/1	1/1	1/1	1/1	1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Worker in a plant where metals were galvanized in heated zinc.	
Rhodium salts	■	1	Merget, Sander et al., 2010	3; case report	1	1	1/1		1/1	nd	nd	nd	nd	nd	nd	0/1	1/1	1/1	nd	nd	1/1	1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Operator of an electroplating	
DYES																																					
Carmine from <i>Dactylopius coccus</i>	★★	11	Tabar-Purroy, Alvarez-Puebla et al., 2003	2-; cross-sectional	24	2 (8.3)	5/24	20.8	2/24	8.3	2/24	8.3	nd	nd	nd	1/14*	6/14**	42.8	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Workers in a dye factory. Same factory and 9 idenic workers as in the study of Quirce, Cuevas et al., 1994 (see below) *FEV1 < 80% **14 workers had either sensitization to carmine allergens or work-related symptoms; 4/6 workers with NSBHR+ had work-related symptoms ***Spec. IgE was present in 4 subjects with positive SPT	
			Quirce, Cuevas et al., 1994	2-; cross-sectional	10	1 (10)	2/10	20	3/10	30	1/10	10	nd	nd	nd	nd	1/10	10	1/10	10	1/10	10	1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	9 dye factory workers, 1 ex-worker with former work-related Asthma *Worker with asthma symptoms is sensitized	

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							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC					SPT		Spec. IgE			
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction				n/n SPT	%	n/n IgE	%	
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%		i					(n)
			Ferrer, Marco et al., 2005	3; case report	1	1	1/1		1/1		1/1		nd		nd		nd		1/1		nd		nd		1/1		1/1		Butcher				
			Acero, Tabar et al., 1998	3; case report	1	1	1/1		1/1		1/1		nd		1/1		nd		1/1*		1/1		1	1/1		1/1		Spice warehouse worker. *PEFR for 6 weeks at work and off-work; oral Ch induced a 50% decrease in PEFR					
			Stücker, Roggenbuck et al., 1996	3; case report	1	1	1/1		1/1		nd		nd		1/1		nd		nd		nd		1/1		1/1		1/1		Flavourer in a food factory				
			Rodriguez, de la Cuesta et al., 1990	3; case report	1	1	1/1		1/1		nd		1/1		1/1		nd		0/1		1/1		1	1/1		nd		1/1		Worker in a factory making carminic acid			
			Burge, O'Brien et al., 1979	3; case report	2	2	2/2		nd		nd		nd		nd		1/2*		nd		nd		2/2		2	0/2		1/2		A worker in a dye factory and a blender of cosmetics. *FEV1 /FVC			
			Añibarro, Seoane et al., 2003 ABSTRACT	3; case report	2	2*	2/2		nd		nd		nd		nd		nd		2/2		nd		2/2		2/2		2/2		2 butchers using a mixture of additives with carmine. *SPT, Spec.IgE and SIC were positive to isolated carmine.				
FD&C Blue Dye No. 2 (Indigotine)	—	1	Miller, Lumms et al., 1996 ABSTRACT	3; case report	1	1	1/1		1/1		nd		1/1		nd		nd		nd		nd		1		0/1		0/1		Worker exposed to FD&C Blue Dye No. 2 and other dyes.				
Henna (black)	—	1	Starr, Yunginger et al., 1997	3; case report	1	1	1/1		1/1		1/1		1/1		nd		*		1/1		1/1		nd		1/1		1/1		Worker in an herbal shop. *mild airway obstruction indicated.				
Lanasol dyes	—	4	Topping, Forster et al., 1989	3+; case series	6	4 (66.6)*	5/6	83.3	4/6	66.6	1/6	16.6	nd		1/6		nd		nd		nd		nd		nd		5/6	83.3	Employees in a wool dye house. *1/5 with asthmatic symptoms was not sensitized.				
Monascus ruber	—	1	Vandenplas, Caroyer et al., 2000	3; case report	1	1	1/1		1/1		1/1		nd		1/1		0/1		1/1		nd		1/1*		1	1/1		1/1		Food manufacturer handling chinese red rice (fermented with <i>M. ruber</i>). *SIC+ with red rice			
Reactive Dyes	**	28	Nilsson, Nordlinder et al., 1993	2; cross-sectional	162	3 (1.8)*	6/162	3.7	8/162	5	nd		7/162	4.3	17/162	10.5	11/13	84.6	3/15	20	nd		nd		5/15	33.3	4/15	26.6	Employees in 15 textile plants (1142 workers). 17 employees with work related symptoms. 15 had further investigation. *3 workers had asthma and were sensitized				
			Park, Kim et al., 2007	2-; caes series	11	11	11/11		nd		nd		nd		nd		8/11*		11/11*		nd		11/11		5	6	11/11*	nd	11 patients with diagnosed occupational asthma by SIC. *After 10 years of exposure cessation and in 2 follow-ups, reduced FEV1 and NSBHR+ persisted although SPT+ had nearly disappeared (SPT+, 3/11)				
			Park, Kim et al., 1989	3+; case series	9	9	9/9		4/9		nd		nd		nd		**		8/9		nd		8/8*		4	4	9/9	8/9	Dye process workers. SIC not performed in 1 worker. **Baseline FEV1 indicated in ml.				
			Romano, Sulotto et al., 1992	3; case report	1	1	1/1		nd		nd		1/1		nd		*		0/1		nd		1/1		1		1/1	nd	Wool and cotton dyer. *mild airway obstruction indicated				
			Alanko, Keskinen et al., 1978	3; case reports	4	4	4/4		4/4		nd		nd		nd		0/4		nd		nd		4/4		1		4/4	3/4	Workers exposed to different reactive dyes				
BIOCIDES																																	
Chloramine T	(*)	9	Kujala, Reijula et al., 1995	3; case report	1	1	1/1		nd		nd		nd		nd		0/1		1/1		nd		1/1		1	1/1		1/1		Cleaner.			
			Blasco, Joral et al., 1992 ABSTRACT	3; case report	1	1	1/1		1/1		nd		nd		nd		nd		nd		nd		1/1		1	1/1		1/1		Dairy worker.			
			Boume, Flindt et al., 1979	3+; case series	7	7	7/7		3/7		nd		4/7		1/7		nd		nd		nd		nd		7/7		nd		Brewery workers				
Glutaraldehyde	—	1	Ohg, Tan et al., 2004	3; case report	1	[1]	1/1		nd		nd		nd		nd		0/1		1/1		1/1		1/1		1		nd	nd	Laboratory technician.				
			Quirce, Gomez et al., 1999	3; case report	1	1	1/1		nd		1/1		1/1		nd		0/1		0/1		nd		1/1*		1	*	0/1	nd	Nurse. *First SIC was negative and turned positive when repeated 1 week later. No late reaction was observed by a nocturnal asthma in the following days.				

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							WORK-RELATED SYMPTOMS												LFT		NSBHR		sPFT		SIC				SPT			Spec. IgE	
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction				n/n SPT	%		n/n IgE	%
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%	i	(n)					
			Gannon, Bright et al., 1995	3+; case series	8	[7]	8/8		nd	nd	nd	nd	nd	nd	0/8		4/8		7/7		7/8				5	2	nd		nd		Endoscopy and x-ray workers. 3 Workers also had SIC+ to formaldehyde.		
			Chan-Yeung, McMurren et al., 1993	3; case report	1	[1]	1/1		nd	nd	nd	nd	nd	1/1		1/1		1/1		1/1				1		nd		nd		Respiratory technologist,			
Chlorhexidine	■	-	Waclawski, McApine et al., 1989	3; case reports	2	[2]	2/2		nd	nd	nd	nd	nd	0/2		½		nd		2/2		2				nd		nd		Nurse			
Hexachlorophene	■	1	Nagy, Orosz et al., 1984	3; case report	1	1	1/1		1/1	nd	nd	nd	nd	nd		1/1		nd		1/1		1				0/1		nd		Children's nurse			
Ortho-Phthalaldehyde	■	-	Fujita, Ogawa et al., 2006	3; case report	1	[1]	1/1		nd	nd	nd	1/1	nd	nd		nd		nd		nd								nd		Medical worker. Diagnose of occupational asthma based on symptoms, clinical examination and treatment effects.			
Peracetic acid-hydrogen peroxide	■	-	Cristofari-Marquand, Kacel et al., 2007	3; case reports	2	[2]	2/2		2/2	2/2	1/2	nd	nd	0/2		2/2		1/1		1/1		1				nd		nd		Nurses. 1 nurse had PFT, the other SIC			
FUNGICIDES																																	
Tetrachloroisophthalonitrile	■	-	Honda, Kohrogi et al., 1992	3; case report	1	[1]	1/1		nd	nd	nd	nd	nd	0/1		1/1		nd		1/1				1	*			0/1		Farmer. *Skin patch test was positive.			
Captafol	■	-	Royce, Wald et al., 1993	3; case report	1	[1]	1/1		1/1	nd	nd	nd	nd	0/1		1/1		1/1		1/1				1	0/1		0/1		Chemical manufacturing worker.				
Tributyl tin oxide (TBTO)	■	-	Shelton, Urch et al., 1992	3; case report	1	[1]	1/1		nd	nd	1/1	nd	nd	0/1		1/1		nd		1/1		1				0/1		nd		Venipuncture technician exposed at work to a carpet sprayed with TBTO.			
Fluazinam and chlorothalonil	■	-	Draper, Cullinan et al., 2003	3; case reports	2	[2]	2/2		nd	nd	nd	nd	nd	½		½		2/2		2/2		2				nd		nd		Workers in a fungicide formulation plant. 1 worker exposed to fluazinam, the other to chlorothalonil.			
ISOCYANATES																																	
Toluene Diisocyanates (TDI)	★★	9	Zedda, Ciria et al., 1976	2; cross-sectional	42	[35 (83.3)]	42/42	100	nd	nd	nd	nd	nd	*		11/18		nd		35/42	83	20	10	5	nd		nd		Workers with symptoms of asthma (33) or asthma and chronic bronchitis (9). SIC was a spray-painting test. **Mean FEV1: 96% predicted				
			Moscata, Delabianca et al., 1991	2; cross-sectional	113	[46 (40.7)]	113/113	100	nd	nd	nd	nd	nd	14/46	30.4	67/113	59.3	nd		46/113	40.7	13	19	14	nd		nd		Employees in polyurethane plastics industries, furniture industry, auto-body repairmen or carpenters. Auto-body repairmen were co-exposed to MDI and were also challenged with it but did not respond.				
			Baur, Fruhmann et al., 1981	3+; cross-sectional	195	9 (4.6)	55/195	28.2	nd	nd	nd	nd	nd	nd		nd		nd		12/17	70.6	5	2	5	nd		9/195	4.6	Workers exposed to TDI. Co-exposure to MDI in a fifth of them. All with Spec. IgE+ were symptomatic and SIC+. SIC was performed in 17 symptomatics.				
			Siracusa, Curradi et al., 1978	3; case report	1	[1]	1/1		nd	nd	1/1	nd	nd	0/1		nd		1/1*		1/1		1				nd		nd		Carpenter. *PEF was a measurement of circadian change of airflow during work after SIC was followed by recurrent nocturnal asthma. The patient was diagnosed as having nocturnal asthma			
Hexamethylene diisocyanate (HDI)	★	3	Vandenplas, Cartier et al., 1993	2; cross-sectional	20	3 (15)*	20/20	100	nd	nd	nd	nd	nd	6/20		15/20	75	nd		10	50	6	1	3	nd		3/19	15.8	*Spray painters. Workers had Spec.IgE+ and Spec. IgG+; 1 other workers had only Spec.IgG+. *Of the 10 workers with SIC+, 3 had IgE and IgG and 1 IgG only.				

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							WORK-RELATED SYMPTOMS												LFT		NSBHR		sPFT		SIC				SPT			Spec. IgE					
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction				n/n SPT	%		n/n IgE	%				
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%	i	(n)						d	(n)		
1,5-naphthylene diisocyanate (NDI)	-	-	Harris, Burge et al., 1979	3; case reports	3	[3]	3/3		1/3		1/3		1/3		nd		nd		nd		1/3		nd		3/3			2	1	nd		nd		Workers in a factory where various isocyanates were Used. Co-exposure to MDI and TDI. SIC with TDI and MDI was negative.			
			Baur, Wieners et al., 2000	3; case report	1	[1]	1/1		nd		nd		nd		nd		nd		nd		1/1		nd		1/1					0/1		0/1		Worker in the plastics industry.			
			Baur, Chen et al., 2001	3; case series	6	[5 (83.3)]	5/6	83.3	2/6	33.3	nd		2/6	33.3	nd		nd		3/6	50	3/6	50	nd		3/6	50	1	1	1	0/6	0	0/6	0	Workers engaged in the production of different synthetic resin articles using NDI. 1 worker had an extrinsic allergic alveolitis associated with pulmonary hemorrhage after NDI exposure.			
Methylene diphenyldiisocyanate (MDI)	*[*]	10	Liss, Bernstein et al., 1988	3+; cross-sectional	26	1	7/26		5/26		nd		nd		nd		nd		nd		nd		*		nd					1/26		1/26**		Core- and mold-area employees who were regularly exposed to MDI. Significant FEV1 decrease in the high exposed group. Individual data not shown. ** Plus Spec.IgG+ in 4 workers.			
			Tse, Johnson et al., 1985	3+; cross-sectional	76	5 (6.6)**	10/76	13.2	nd		nd		40/76	52.6	nd		nd		nd		10/76	13.2	nd		nd						2/76*	2.6	2.6	Foundry workers. Spec. IgG+ in five workers. ** the 5 asthma cases had either Spec.IgE+ or Spec. IgG+.			
			Zammit-Tabona, Sherkin et al., 1983 ABSTRACT	3+; case series	11	2 (18.2)**	11/11	100	nd		nd		nd		*		*		nd		6/11	54.5			4	2	nd				2/11	18.2	18.2	Foundry workers. Co-exposure to formaldehyde but SIC was negative in all 11 workers. *SIC+ workers had more evidence of air-flow obstruction in LFT and greater NSBHR than the others. ** 1 was SIC.			
			Stingini, Bellini et al., 2008	3; case report	1	1	1/1		nd		nd		1/1		nd		nd		nd		1/1				1						1/1		1/1		Worker in a chemical factory manufacturing adhesives. He was diagnosed as also having occupational contact urticaria by patch test.		
			Donnelly, Buick et al., 2004	3; case report	1	[1]	1/1		nd		nd		nd		0/1		nd		nd		1/1				1						nd		nd		Nurse.		
			Perfetti, Brame et al., 2003	3; case report	1	[1]	1/1		nd		nd		nd		0/1		0/1		nd		1/1				1						nd		nd		Worker in a toy manufacture. Symptoms started after an accident spill of MDI in her work area and persisted until removal from exposure.		
			Valks, Conde-Salazar et al., 2003	3; case report	1	1	1/1		nd		nd		1/1		nd		nd		nd		1/1										nd		1/1		Worker in a factory where plastic components were manufactured. Spec. IgE and SIC + to MDI and TDI. Worker was diagnosed as having occupational contact urticaria and asthma.		
Various isocyanates (TDI, HDI)	*[*]	22	Deschamps, Sow et al., 1998	3+; cross-sectional	96	2 (2.1)	44/96	45.8	nd		nd		nd		nd		nd		nd		nd										nd		2/68	3	3	Workers engaged in isocyanate processing.	
Various isocyanates			O'Brien, Newman-Taylor et al., 1979	3+; cross-sectional	24	[16 ('66.6)]	24/24	100	nd		nd		nd		nd		12/24	50	nd													nd		nd		Workers handling diisocyanates. Probably cross-reactivity between the different isocyanates because 8/16 subjects with asthmatic reactions to TDI reacted to MDI, and 3 of these 8 also reacted to HDI.	
TDI																					16/24	66.6			5	11											
MDI																					8/24	37.5			4	4											
HDI																					3/9	33.3			1	2											
Various isocyanates			Cartier, Grammer et al., 1989	3+; case series	62	9 (14.5)	62/62	100	nd		nd		nd		14/62	22.6	46/62	74.2	nd														9/62**	14.5	14.5	Workers exposed to various isocyanates. *SPT done in 7/9 workers with Spec.IgE+ or Spec. IgG+. **9 workers had Spec. IgE and Spec.IgG antibodies. No worker had only Spec. IgE antibodies but 20 only Spec.IgG.	
TDI					6																4/6	66.6			7	15	7										
MDI					17																10/17	58.8							1/7*				14.3				
HDI					39																15/39	15.39							6/7				85.7				
Various isocyanates			Pezzini, Riviera et al., 1984	3+; case series	28	11 (39.3)	28/28	100	nd		nd		nd		nd		9/28	32.1			28/28	100			9	12	7	nd					11/28	39.3	39.3	Workers exposed to TDI or MDI.	
TDI					22																5/6											83.3					
MDI					6																6/22											27.3					
Various isocyanates			Minov, Karadzinska-Bislimovska et al., 2008	3; case reports	2	[2*]	2/2		nd		nd		nd		0/2		2/2		1/2		nd										nd		nd		Automobile painters with isocyanate-based aerosol paint. *One patient with occupational asthma, the other patient was diagnosed as having work-exacerbated asthma.		
Triglycidyl isocyanurate (TGIC)	-	-	Pirila, Estlander et al., 1997	3; case report	1	[1]	1/1		nd		nd		1/1		0/1		1/1		1/1		1/1									1	0/1		0/1		Spray painter		
ANHYDRIDES																																					
Tetrachlorophthalic anhydride	(*)	7	Schlueter, Banaszak et al., 1978	3+; case series	5	[5]	5/5		nd		nd		nd		2/3		3/4		1/1*		3/3*									2	1	nd		0/5		Workers in the production of epoxy resin. One worker couldn't have SIC because of his condition, the other had spirometric decreases in PFT and no further investigation with SIC.	

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							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE				
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction			n/n SPT	%	n/n IgE	%	
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%						i
			Howe, Venables et al., 1983	3+; case series	7	7	7/7		nd		1/7		2/7		nd		nd		0/7		nd		4/4		2	2	7/7		*	Workers exposed to an epoxy resin powder containing TCPA. * RAST to TCPA-HSA were significantly elevated in all of the 7 asthmatic workers.		
Phthalic anhydride	*[*]	6	Nielsen, Welinder et al., 1988	3+; cross-sectional	60	1 (1.7)	5/60	8.3	19/60	31.6	21/60	35	nd		nd		nd		0/5*	0	2/3*	66.6	nd				1/1*		1/1*	1/1*	Workers in 2 plants producing alkyde and unsaturated polyester resins. Time-weighted average concentration were 6.6 mg/m3. Probably the same plants as in Wernfors, Nielsen et al., 1986. *LFT, NSBHR, SIC, SPT and Spec. IgE of the 5 workers with asthma.	
			Wernfors, Nielsen et al., 1986	3+; cross-sectional	118	4 (3.4)	21/118	17.8	28/118	23.7	nd		nd		nd		nd		4/13*	30.8	3/11*		nd		2/2*	100		2	4/11*	36.4	nd	Workers in 4 plants producing alkyd or polyunsaturated polyester resins. Time-weighted average concentration were 3-13 mg/m3. 13 workers had chronic bronchitis. *LFT, NSBHR, SIC and SPT were only performed in 11 out of the 21 asthmatics. 2 out of 11 asthmatics had Prausnitz-Kütznertest and 4 non-asthmatics heavily sensitized.
			Ward and Davies, 1982	3; case report	1	[1]	1/1		1/1		nd		nd		nd		nd		1/1		nd		1/1				1	nd		nd	Worker grinding metals and solid plastics. Asthma occurred after working with cured resin.	
			Maccia, Bernstein et al., 1976 ABSTRACT	3; case report	1	1	1/1		1/1		1/1		nd		nd		nd		nd		nd		1/1		1		nd		1/1		Worker exposed to phthalic anhydrides	
Phthalic anhydride and chlondendic anhydride	-	1	Keskinen, Pfläffli et al., 2000	3; case report	1	1	1/1		nd		nd		nd		1/1		1/1		nd		1/1		nd				1/1		1/1		Mechanic.	
Methyl tetrahydrophthalic anhydride (MTHPA)	*	3	Nielsen, Welinder et al., 1992	3+; cross-sectional	170	2 (1.2)*	18/170	10.6	94/170	55.3	51/170	30	16/170	9.4	nd		nd		nd		34/170	20	nd				25/170	14.7	28/170	16.5	144 workers exposed to MTHPA and 26 subjects previously exposed in the same factory. *55 current and the 26 former workers were highly exposed. In this group, 2 had asthma and were sensitized. The other sensitization rates are not indicated.	
			Nielsen, Welinder et al., 1989	3; case report	1	1	1/1		1/1		nd		nd		nd		nd		0/1		1/1		nd				1/1		1/1		Worker exposed to MTHPA.	
Hexahydrophthalic anhydride	*	5	Møller, Gallagher et al., 1985	2+; cross-sectional	27	4 (14.8)*	4/27	14.8	10/27	37	13/27	48.1	nd		nd		nd		0/27	0	nd		0/27	0	nd				nd	12/27	44.4	Workers with occupational exposure to hexahydrophthalic anhydride. *4 workers had work related asthma, they also had Spec. IgE+.
			Chee, Lee et al., 1991	3; case report	1	1	1/1		nd		nd		nd		nd		nd		nd		nd		1/1		1	nd		nd		nd	Laboratory technician.	
Maleic anhydride	-	1	Lee, Wang et al., 1991	3; case report	1	1	1/1		1/1		nd		nd		nd		nd		nd		1/1		1/1			1	nd		nd		Assistant technician. Co-exposure to phthalic anhydride.	
Trimellitic anhydride	[*]	4	Zeiss, Patterson et al., 1977	3+; cross-sectional	14	4 (28.6)	4/14	28.6	4/14	28.6	nd		nd		nd		*		nd		nd		nd			4/4	100	%		Industrial workers exposed during the chemical manufacture of TMA. *The 4 asthma cases also suffered from rhinitis, 4 workers had respiratory symptoms with malaise, fever, chills etc. and 6 workers had irritant respiratory symptoms. SPT+ and IgE+ cases are asthma		
Various anhydrides	-	-	Fawcett, Newman Taylor et al., 1977	3+; case series	7	[6 (85.7)]	6/7	85.7	nd		nd		nd		nd		nd		5/7**		nd		nd		5/7**	71.4			nd	nd	Workers exposed to epoxy resin systems. 1 worker with chronic bronchitis. *LFT was indicated as a mild obstruction. **The sixth worker with asthma was SIC+ to TDI	
Phthalic acid anhydride																																
Trimellitic acid anhydride																																
Triethylene tetramine																																
AMINES																																
Amino-ethyl ethanolamine	-	-	Pepys and Pickering, 1972	3; case reports	3	[3]	3/3		nd		nd		nd		nd		0/3*		nd		nd		3/3			1	2	nd	nd		Cablejoints exposed to amino-ethyl ethanolamine. * 1 with signs of mild airways obstruction.	
Dimethyl ethanolamine	-	-	Vallieres, Cockcroft et al., 1977 ABSTRACT	3; case report	1	[1]	1/1		1/1		nd		1/1		nd		nd		nd		*		1/1			1	0/1		nd		Spray painter. *Decrease in PFT.	
Ethylenediamine	-	2	Lam and Chan-Yeung, 1980 ABSTRACT	3; case report	1	[1]	1/1		nd		nd		nd		nd		nd		nd		nd		1/1		1	0/1		0/1		0/1	Worker developing color photographs.	

Agents	Strength of evidence per agent (three star system of RCGP)	Total no. of allergic asthma cases per agent, n	Reference	Level of evidence per study (revised SIGN grading system); study type.	Occupationally exposed subjects studied, n	Allergic asthma cases due to mentioned agent, n, prevalence (%). Cases with probable allergic asthma but specific sensitization not confirmed in parentheses [] or not indicated.	EVIDENCE (pathological results)																				Remarks					
							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE				
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction			n/n SPT	%	n/n IgE	%	
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%						i
			Nakazawa, Matsui	3; case reports	2	2	2/2		nd		nd		nd		nd		0/2		2/2		nd		2/2		2		nd		2/2		Employee in a chemical factory	
			Ng, Lee et al., 1991 ABSTRACT	3; case report	1	[1]	1/1		nd		nd		nd		nd		nd		1/1		1/1		1/1		1		nd		nd		Chemical worker.	
Ethanolamine and triethanolamine	■	-	Savonius, Keskinen et al., 1994	3; case reports	3	[3]	3/3	2/3	1/3	1/3	1/3	nd	nd		0/3		1/3		3/3		3/3		2	1	nd		nd		nd		Workers exposed to azodicarbonamide.	
Diethanolamine	■	-	Pipari, Tuppurainen et al., 1998	3; case report	1	[1]	1/1		nd		nd		nd		0/1		1/1		1/1		1/1		2	1	nd		nd		nd		Worker welding black iron.	
Paraphenylenediamine	■	-	Silbermann and Sorrell, 1959	2; cross-sectional	80	[59 (73.8)]	59/80*	73.8	38/80		nd	4/80	5	18/80	22.5	nd		nd		nd		37/50	74				nd**		nd		Fur workers. *30 had only asthma symptoms, 29 had asthma and other allergies. ** Patch test was done in workers with 47 workers with asthma, 31 were positive after several hours until 4 days after.	
Piperazine	■	-	Hagmar, Bellander et al., 1982	3+; cross-sectional	130	[29 (22.3)]	29/130	22.3	nd		nd	nd	nd	nd	nd	19/107	17.8	5/7	71.4		nd		1/1		1		nd		nd		Factory workers handling amines. 33 were diagnosed with asthma, 29 due to piperazine, 3 due to ethylenediamine and 1 due to an antiparasitic drug.	
Piperazine dihydrochloride	■	1	Pepps, Pickering et al., 1972	3; case reports	2	1+[1]	2/2		nd		nd		nd		0/2		nd		nd		272		2		½		nd		nd		Chemists.	
Piperazine and n-methyl-piperazine	■	2	Welinder, Hagmar et al., 1986	3; case report	2	2	2/2		nd		nd		nd		0/2		0/1		nd		nd					½		2/2		Workers in a chemical plant.		
Piperazine citrate	■	1	Quirce, Pelta et al., 2006	3; case report	1	1	1/1		1/1		nd		nd		0/1		1/1		nd		1/1		1		1/1		nd		nd		Process operator in a chemical factory	
OTHER CHEMICALS																																
3-amino-5-mercapto-1,2,4-triazole	■	-	Hnizdo, Sylvain et al., 2004		45	[6*]	11/45		42	31		22	nd	nd		8/42	19	3/26		3/10		nd					nd		nd		Workers in a specialty chemical plant. Survey after report of 8 new-onset cases. * 6 of 11 asthma cases with criteria of OA, sensitization is not confirmed.	
Azodicarbonamide	■	-	Slovak, 1981	2; cross-sectional	151	[28 (18.5)]	28/151	18.5	8/28	28.5	7/28	25	11/28	39.3	nd	nd	0/151	0	nd		0/151	0	nd				0/151	0	nd		Workers exposed to azodicarbonamide dust; weighted average levels in the range of 2-5 mg/m3.	
			Malo, Pineau et al., 1985	3; case report	2	[2]	2/2		½		½		nd	nd	nd	2/2		2/2		nd		2/2		1	1	nd		nd		nd		Workers exposed to azodicarbonamide.
			Normand, Grange et al., 1989	3; case report	4	[4]	4/4		nd		nd		nd	nd	nd	½		nd		nd		2/4		1	1	nd		nd		nd		Workers exposed to azodicarbonamide.
			Kim, Cho et al., 2004	3; case report	1	[1]	1/1		nd		nd		nd	nd	1/1		1/1		0/1		1/1		1/1		1		0/1*		nd		Worker in an azodicarbonamide producing factory. *Patch-test was positive after 48 and 96 hours.	
Epoxy resin	■	1	Hannu, Frilander et al., 2008	3; case report	1	1	1/1		1/1		nd		1/1	nd	0/1		1/1		nd		1/1		1		1/1		1/1		1/1		Construction worker	
Formalin	■	1	Hendrick and Lane et al., 1975	3; case reports	2	[1]	2/2		½		nd		nd	nd	nd		nd		nd		½		1		nd		nd		nd		Nurse and pathologist exposed to formalin.	
			Hendrick and Lane et al., 1975	3+; survey	28	[2 (7.1)]	5/28	17.9	nd		nd		nd	nd	0/28	0	nd		nd		2/4	50	2		nd		nd		nd		Staff of a haemodialysis unit.	
Formaldehyde			Burge, Harries et al., 1985	3+; case series	15	[3 (20)]	15/15	100	1/1		nd		nd	nd	nd		4/14	28.6	nd		7/15	46.6	4	3		nd		nd		Workers occupationally exposed to formaldehyde. Co-exposure to isocyanates, phenol or other chemicals. Workers with immediate SIC reactions also had NSBHR + and the symptoms are indicated to be due to an irritant effect of formaldehyde.		

Agents	Strength of evidence per agent (three star system of RCGP)	Total no. of allergic asthma cases per agent, n	Reference	Level of evidence per study (revised SIGN grading system); study type.	Occupationally exposed subjects studied, n	Allergic asthma cases due to mentioned agent, n, prevalence (%). Cases with probable allergic asthma but specific sensitization not confirmed in parentheses [] or not indicated.	EVIDENCE (pathological results)																								Remarks		
							WORK-RELATED SYMPTOMS												LFT		NSBHR		sPFT		SIC				SPT			Spec. IgE	
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction				n/n SPT	%		n/n IgE	%
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%	i	(n)					
			Nordman, Keskinen et al., 1985	3+; case series	230	[12 (5.2)]	230/230	100	nd	nd	nd	nd	nd	nd	nd	1/12	8.3	8/11	72.7	3/12	25	12/12	100	6	4	2	nd	nd	nd	230 subjects exposed to formaldehyde; mean concentration: 4.8 mg/m ³ . 12 considered as having occupational asthma after LFT, SIC and NSBHR. These are only indicated for the 12 cases here.			
			Grammer, Harris et al., 1993	3; case report	1	1	1/1	nd	nd	nd	nd	nd	nd	nd	0/1	0/1	nd	nd	0/1	nd	nd	nd	nd	nd	nd	nd	nd	1/1	Worker in a formaldehyde manufacturing plant.				
			Kim, Song et al., 2001	3; case report	1	[1]	1/1	nd	nd	nd	nd	nd	nd	nd	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1	1	0/1	0/1	0/1	0/1	0/1	Worker exposed to formaldehyde. Co-exposure to other chemicals.				
Persulphate salts	*	20	Schwaiblmair, Vogelmeier et al., 1997	2-, cross sectional	55	13 (23.6)	38/55	69.1	31/55	56.4	nd	nd	15/55	27.3	nd	0/55	0	32/55	58.2	nd	nd	9/46	19.6	5	4	13/55	23.6	nd	Hairdressers exposed to persulfate salts. SPT+ and SIC+ subjects were out of the symptomatic group.				
			Parra, Igea et al., 1992	3; case report	1	1	1/1	nd	nd	nd	nd	1/1	nd	nd	0/1	1/1	0/1	0/1	1/1	1/1	1/1	1	1	1/1	0/1	0/1	0/1	0/1	Hairdresser.				
			Pepys, Hutchcroft et al., 1976	3; case reports	1	1	1/1	1/1	1/1	1/1	nd	nd	nd	nd	0/1	nd	nd	nd	1/1	1/1	1/1	1	1	1/1	1/1	nd	nd	nd	Hairdresser. Co-exposed to henna. SIC+ with henna (immediate asthma response)				
			Munoz, Cruz et al., 2003	3+; case series	8	5 (62.5)	8/8	100	6/8	75	nd	nd	3/8	37.5	nd	7/8	87.5	7/8	87.5	nd	nd	7/7	100	1	5	1	5/8	62.5	nd	Hairdressers and cosmetician exposed to persulfate salts.			
			Moscato, Pignatti et al., 2005	3+; case series	47	[21 (44.7)]*	47/47	100	11/47	23.4	nd	nd	17/47	36.2	nd	0/47	0	14/33	42.4	nd	nd	21/47	44.7	4	14	3	0/14	0	nd	Hairdressers. SIC performed with ammonium persulfate and SIC+ with permanent hair dyes in 2 cases and in 1 with latex. *Co-exposure to permanent hair-dyes; in 21 cases occupational asthma due to persulfates confirmed.			
Polyfunctional aziridine	*	4	Kanerva, Keskinen et al., 1995	2-; cross-sectional	9	4 (44.4)	7/9	77.7	4/9	44.4	nd	nd	4/9	44.4	nd	nd	2/9	22.2	nd	nd	7/9	77.7	1	5	1	4/4	100	0/5	0	Workers exposed to PFA (parquet layers, fibreboard Spray painter, salesman).			
WORKSITES																																	
Farming																																	
Farming	**	30	Walusiak, Krawczyk-Adamus et al., 2004	2+; case-control	100	30 (30)	79/100	79	92/100	92	38/100	38	83/100	83	nd	100/100	100	nd	x*	nd	nd	38/100	38	15	47/100	47	nd	nd	Randomly selected symptomatic workers in small nonspecialized farming. *Results not listed; 38 subjects had OA (SIC+ or BHR+), 41 subjects had ORh (nasal Ch+); 30/38 subjects with OA were SPT+ to occupational allergens (25/38 SPT+ to hay or straw, 17/38 SPT+ to cereals, 11/38 SPT+ to storage mites, 7/38 SPT+ to animals); cereal farming and SPT+ to cereals and SPT+ to storage mites were sign. risk factors of OA and/or ORh				
animals																																	
cereal																																	
hay and straw																																	
storage mites																																	
Co-exposure to various lab animals																																	
Laboratory animals: urinary proteins from rat, mouse and dander from rabbit	***	140	Gautrin, Infante-Rivard et al., 2001	2+; prospective cohort study over 3-4 years.	373	28 (7.5)*	22/373	5.9*	99/373	26.5*	nd	nd	81/373	21.7*	94/370	25.4	nd	53/203	26.1	nd	nd	nd	nd	nd	129/373	34.6*	nd	nd	Animal laboratory apprentices. Peak incidents of SPT+ are max. 1-2 years after begin of exposure, and that of OA throughout the first 3 yrs; OA cases: subjects with SPT+ and 3.2 fold decrease in PC20, only 8/28 OA cases had asthmatic WRS; *cumulative incidence ratio				
Laboratory animals: urinary proteins from rat, mouse, rabbit and dander from rabbit			Gautrin, Ghezzi et al., 2002	2+; prospective cohort study over 32 or 44 months	395	27 incident cases	27/395*		115/364*		115/364*	nd	nd	nd	nd	nd	nd	30/395	7.6	nd	nd	nd	nd	nd	85/395*	nd	nd	nd	Apprentices in animal-health technology. *Incident cases at 32 or 44 months; 30/85 SPT+ subjects had significant changes in NSBHR+ referred to as 30 incident cases of probable OA, 9/30 had asthma symptoms at baseline, 9/30 had asthma symptoms at follow-up				
Laboratory animals (rats, rabbits, mice, guinea pigs)			Botham, Davies et al., 1987	2+; prospective cohort study	383	[6 incident cases]	6/383	1.6*	22/383	5.7*	11/383	2.9*	nd	12/383	3.1*	36/383	9.4*	nd	nd	nd	nd	nd	nd	nd	**	**	**	**	Laboratory animal workers during their first 3 years of exposure at research facilities. *Incidence after 1 year of exposure; **after 1 year of exposure 40-64 % of the 36 symptomatics were IgE+ to rat, and 70-86% to at least one animal; sensitized asthmatics not listed				
Laboratory animals: rat, mouse, guinea pig, rabbit			Kruize, Post et al., 1997	2+; retrospective cohort study	99	8 (8.2)*	8/98	8.2*	14/98	14.3*	11/98	11.2*	nd	15/98	15.3*	19/99	19.2*	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Laboratory animal workers. Average time of follow-up 9.7 yrs; *cumulative incidence ratio; incident density ratio for WRS: 19.7 per 1000 person-years; exposure and atopy were sign. predictors of WRS				

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							WORK-RELATED SYMPTOMS												LFT		NSBHR		sPFT		SIC				SPT			Spec. IgE			
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	%	n/n NSBHR	%	n/n PFT	%	Reaction				n/n SPT	%		n/n IgE	%		
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%							n/n SIC	%	i	n						l	d
Laboratory animals: rat, mouse, rabbit, hamster, guinea pig, cat, dog			Krakowiak, Palczynski et al., 2002	3+; cross-sectional	68	7 (10.3)	7/68	10.3	16/68	23.5	19/68	27.9	nd	nd	nd	nd	x*	nd	nd	nd	nd	nd	nd	nd	nd	nd	21/68**	30.8	12/21***	57.1	Zoo workers, co-exposed and co-sensitized to feathers. *Individual results not listed; **SPT with fur extract; ***IgE in SPT+				
Laboratory animals: guinea pigs, rats, mice, rabbits, hamsters			Krakowiak, Szulc et al., 1997 ABSTRACT	3+; survey	60	5 (8.3)	8/60	13.3	4/60	6.7	nd	nd	nd	nd	nd	+	+														Laboratory animal workers. *SPT in atopics; 5 subjects with OA had SPT+ and IgE+ to at least one animal				
BAKERY CONFINEMENT																																			
Alkaline hydrolysis wheat gluten derivative (AHGD)	-	1	Lachance, Cartier et al., 1988	3; case report	1	1	1/1		1/1	1/1	nd	nd	1/1	0/1	0/1	nd	1/1	1								1/1	1/1				Employee in a biscuits producing company. SPT- with individual extracts of cereals; SIC- with wheat				
Bakery	**		Brisman, Järnholm et al., 2000	2+; retrospective cohort study	2226	[incident density ratio: 3]	30/2226	1.3*	253/2226	11.4*	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Bakers. *Cumulative incidence ratio; incident density ratio (number of new cases/1000 person-years) for asthma: 3.0, for rhinitis 30.0; sign. association between the dust concentration at onset of disease and the risk for asthma or rhinitis, but not of the cumulative exposure; same cohort as Brisman, Järnholm 1995				
Bakery			Brisman et Järnholm, 1995	2+; retrospective cohort study	2226	[incident density ratio: 3]	*		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Persons trained as bakers answered a postal questionnaire. *Incidence rate for asthma among men who worked as bakers 3.0 cases per 1000 person-years; same cohort as Brisman, Järnholm 2000				
Bakery			Cullinan, Cook et al., 2001	2+; prospective cohort study	300	Incidence: 1	36/300***	4.1*	87/300	11.8*	87/300	11.8*	nd	33/300	3.5*	109/300	nd	nd	nd	nd	nd	nd	nd	nd	nd	35/300**					Bakery and flour mill workers without previous exposure followed for a median of 40 (1-91) months. *Incidence (cases per 100 py); **SPT+ to either flour or α-amylase; ***incidence of sensitized asthmatics was 1 case per 100 person years; sign. association between exposure and WRS and SPT+				
Alpha-amylase																											2.5*								
Flour																											2.2*								
Bakery			Brisman, Lilienberg et al., 2003	2+; nested clinical case-referent study	45		25/45		20/45		nd	nd	nd	45/45			*	18/25**		nd	nd	nd	nd	nd	nd	17/45***				nd	Bakers. *Sign. lower mean FEV1 in asthmatics; **BHR in asthmatics; ***SPT+ with flour and/or alpha-amylase; OR for SPT+ to flour or alpha-amylase for new-onset asthma was 5.8-7.0				
Alpha-amylase																																			
Flour (any)																																			
Bakery			Houba, Heederik et al., 1998	2+; cross-sectional	393		29/393	7.4	83/393	21.1	58/393	14.8	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd						Bakery workers. 15/91 asthmatics and/or with rhinitis were IgE+; asthmatics with IgE+ not listed			
Alpha-amylase																																			
Wheat flour																																			
Bakery			Cullinan, Lowson et al., 1994	2+; cross-sectional	344		46/322	14.3	92/322	28.6	92/322	28.6	nd	27/322	8.4	58/264*	22.0	nd	nd	nd	nd	nd	nd	nd	nd	nd							Bakery and flour mill workers. Initial cross-sectional survey of the same cohort of Cullinan, Cook et al., 2001.		
Alpha-amylase																																			
Mixed flour																																			
Lepidoglyphus destructor																																			
Bakery (wheat flour)			Talini, Benvenuti et al., 2002	3+; survey	297	5 (1.7)	*		nd		nd	nd	nd	nd	nd	nd	57/283*	20.1	22/62**		nd	nd	nd	nd	6/15***		1	3	2	37/283	13.1	nd	111 millers from 3 mills, 186 bakers from 2 bakeries. *82 subjects who had asthma-like symptoms and/or FEV1 <83% were selected for further tests, **62/82 asthmatics underwent NSBHR;***SIC done in 15 NSBHR+ subjects; 3/6 SIC+ were SPT+; 2/3 subjects previously diagnosed with OA were SPT+		
Bakery			Musk, Venables et al., 1989	2+; survey	279	[30 (10.75)]	30/234*	12.8	44/234*	18.8	nd	nd	nd	59/234*	25.2	22/239	9.2	81/249	32.5	nd	nd	nd	nd	nd	nd	nd	99/259	38.2	nd			Bakers. *WRS in main exposure group			
Acarus siro																																			
Glycyphaeus destructor																																			
Glycyphaeus domesticus																																			
Tyrophagus longior																																			
Tyrophagus putrescentiae																																			
Tribolium confusum																																			
Mixed flour																																			
Wheat grain																																			
Mould mix																																			
Baker's yeast																																			
Aspergillus fumigatus																																			
Bakery			Smith, Lumley et al., 1997	3+; cross-sectional	383	2 (0.5)	2/383	0.5	10/383	2.6	nd	nd	nd	78/383*	20.4	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd							Bakers from 19 plant bakeries. *Short-lived WRS, referred to as non-specific respiratory irritation; both asthmatics were SPT+ to amylase, 1/2 asthmatics SPT+ to wheat, soya and rice		
Alpha-amylase																																			
Rice flour																																			
Soya flour																																			
Wheat flour																																			
Bakery			Droste, Myrny et al., 2003	2+; cross-sectional	246	.*	*		*		*	nd	*	56/246	22.8	**	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	37/246**	15.0	nd			Bakers. *Individual symptoms not listed; **sign. lower FEV1/FVC ratio; **SPT+ to any bakery allergen; sign. increased risk of WRS and SPT+, and sign. association between SPT+ and WRS			
Alpha-amylase (fungal)																																			
Rye																																			

Agents	Strength of evidence per agent (three star system of RCGP)	Total no. of allergic asthma cases per agent, n	Reference	Level of evidence per study (revised SIGN grading system); study type.	Occupationally exposed subjects studied, n	Allergic asthma cases due to mentioned agent, n, prevalence (%). Cases with probable allergic asthma but specific sensitization not confirmed in parentheses [] or not indicated.	EVIDENCE (pathological results)																				Remarks			
							WORK-RELATED SYMPTOMS										LFT		NSBHR		sPFT		SIC			SPT		Spec. IgE		
							Asthma		Rhinitis		Conjunct.		Cough		Skin		Total		n/n LFT	n/n NSBHR	n/n PFT	n/n SIC	Reaction			n/n SPT		n/n IgE		
							n/n Ast	%	n/n Rhin	%	n/n Conj	%	n/n Cou	%	n/n Skin	%	n/n Tot	%					% i	(n) l	(n) d				(n) m	%
			Valdivieso, Moneo et al., 1989	3; case report	1	1	1/1		1/1		nd	nd	1/1	1/1	0/1	1/1	nd	1/1			1	1/1	1/1	1/1	1/1	1/1	Creperie worker			
			Park and Nahm, 1996	3; case report	1	1	1/1		1/1		nd	nd	nd	1/1	nd	nd	nd	1/1		1		1/1	1/1	1/1	1/1	Buckwheat flour noodle maker. Also IgE+ and SPT+ with wheat flour				
			Choudat, Vilette et al., 1997 ABSTRACT	3; case report	1	[1]	1/1		nd		nd	nd	nd	1/1	nd	nd	nd	1/1		1		nd	nd	nd	nd	Pancake maker. SIC- with wheat flour				
Rye flour (<i>Secale cereale</i>)	(*)	7	Armentia, Garcia Casado et al., 1997	3; case series	9	5 (55.5)	4/9	44.4	8/9	88.8	8/9	88.8	nd	9/9	100	nd	5/9	55.5	nd	5/9*	55.5			9/9	100	9/9	100	Carpenters. *Reaction type not listed; 9/9 conj Ch+		
			Letran, Palacin et al., 2008	3; case reports	2	2	2/2		2/2		2/2	nd	nd	0/2		2/2	1/1	2/2*	2			2/2	2/2	2/2	2/2	Bakers, SIC+and Spec.IgE+ for rye flour, not to wheat flour.				
Soybean processing (Bakery, animal feeding, food processing)																														
Soybean	*[+]	31	Zuskin, Skuric et al., 1988	2-; survey	27	[2 (7.4)]	8/27	29.6	9/27	33.3	12/27	44.4	15/27	55.6	nd	nd	7/27	nd	x*	nd			nd	nd	nd	nd	Soy bean workers. *Sign. cross-shift decrease on monday and friday; 2 subjects had OA defined as WR asthmatic symptoms and PFT+			
Soybean			Cummings, Gaughan et al., 2010	2-; cross-sectional	147	6*	18/147	12	12/147	8	nd	11/147	8	nd	nd	15/136	11	12/102	12	nd	nd			9/132	7	28/135	21	Workers in a soy processing plant. Participation Rate: 52%. 6 workers had work-related asthma symptoms and had high levels of spec. IgE to soy.		
Soybean			Zuskin, Kanceljak et al., 1991	2-; cross-sectional	19	2 (10.5)	6/19	31.6	7/19	36.8	10/19	52	11/19	57.9	nd	nd	x*	nd	x*	nd			19/19**	100	3/19	15.8	Soybean workers. *Sign. lower pre-shift FVC, FEV1, and FEF25, also sign. cross-shift reduction of FVC, FEV1, FEF50, and FEF25; **IC, OA defined as WR asthmatic symptoms and LFT+			
Soybean (Hull)			Maggio, Monso et al., 2003	3; case report	1	1	1/1		nd		nd	nd	nd	0/1	1/1	1/1	nd	1/1*		1		1/1	1/1	nd	nd	Worker in an animal feed factory. *First SIC with soya flour was negative, a second SIC with soybean hull was positive.				
Soybean hulls				3+; case series	31	*	*	*		nd	nd	nd	31/31	nd	nd	nd	nd	nd	nd	nd			12/31	7/12**			Study of the prevalence of sensitization in 365 subjects with asthma and /or rhinitis, of whom 31 were occupationally exposed.			
Soybean flour			Baur, Pau et al., 1996	3+; case series	14	12 (85.7)	12/14	85.7	7/14	50	3/14	21.4	2/14	14.3	1/14	7.1	14/14	100	nd	nd	nd	nd	nd	14/14	100	14 symptomatic bakers with 14/14 IgE+ to crude soybean flour, 12/13 IgE+ to wheat, 10/13 IgE+ to rye and 5/13 IgE+ to alpha-amylase (<i>A. oryzae</i>)				
Soybean lecithin																														
Soybean lipoxidase																														
Soy trypsin inhibitor																														
Soybean lecithin			Lavaud, Perdu et al., 1994	3; case reports	2	2	2/2		2/2		nd	2/2	nd	2/2	nd	nd	nd	2/2		2		2/2	2/2	2/2*			Bakery employees. *IgE+ with soybean flour; additionally 2/2 SPT+ with soybean dust, flour, pulp; 1/2 SPT+ with wheat, bakery dust; 2/2 IgE+ with soybean flour; 1/2 IgE+ with wheat			
Soybean trypsin inhibitor			Quiroce, Fernández-Nieto et al., 2002	3; case reports	2	2	2/2		nd		nd	nd	nd	2/2	nd	2/2	nd	2/2		2		2/2	2/2	2/2	2/2		Bakers. Also 2/2 SPT+, IgE+, SIC+ with wheat flour and soybean flour			
Soybean flour			Quiroce, Polo et al., 2000	3; case reports	4	4	4/4		4/4		4/4	nd	nd	nd	nd	4/4		4/4		3		1	4/4	3/4			Bakers and/or confectioners.			
Soybean flour			Roodt and Rees, 1995	3+; survey	22	0*	0/22*		nd		nd	5/22	22.7	nd	nd	nd	nd	nd	nd	nd			8/22	36.4	8/22	36.4	Workers in soy bean mill. *0/22 subjects with WRA, defined as wheeze with chest tightness, 5/22 subjects had WR breathlessness, which was sign. higher in exposed subjects			
Soybean flour			Bush, Schroeckenstein et al., 1988	3; case report	1	1	1/1		1/1		nd	1/1	nd	1/1	1/1	1/1	1/1	1/1	nd	1/1		1	1/1	1/1	1/1		Food-processing plant worker			
			Bush, Cohen et al., 1977	3; case report	1	1	1/1		1/1		1/1	1/1	nd	1/1	0/1	1/1	nd	1/1		1		1/1*	0/1			Secretary of a dairy food product company. *IC				
Brewery																														
Brewery	-	-	Godnic-Cvar, Zuskin et al., 1999	2-; cross-sectional	97	[2 (2.1)]	30/97	30.1	5/97	5.2	37/97	38.1	15/97	15.5	nd	nd	*	nd	**	nd					15/97	15.5	Brewery workers. *Sign. decreased FVC, FEV1, FEF50, and FEF25 as compared to predicted; **sign. cross-shift changes; 2 OA, defined as WR asthmatic symptoms and PFT+, but not listed whether sensitized; sign. higher prevalence of WRS and SPT+ with mold, hops, and barley in exposed			
Barley																														
Brewer's yeast																														
Corn																														
Grain weevil (<i>Sitophilus granarius</i>)																														
Hops (<i>Humulus lupulus</i>)																														

