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1 **Executive summary**

2 **Background**

3 The most significant occupational skin problem potentially encountered in wet work occupations is
4 occupational dermatitis. When the skin comes into contact with hazardous substances at work, this
5 can cause occupational dermatitis to occur. Substances which might cause occupational dermatitis
6 include cleaning products, organic solvents, metalworking fluids, cement, flour, adhesives, other
7 chemicals, and even certain plants. Occupational skin disease has adverse effects on quality of life
8 and the long term prognosis for skin health is poor unless workplace exposures are addressed. To
9 date, no systematic review has been undertaken to determine the effectiveness of interventions for
10 the primary prevention of Occupational Irritant Hand Dermatitis (OIHD) in wet workers.

11 **Objective**

12 The aim of this review was to identify, appraise and synthesize the best available evidence on the
13 effectiveness of moisturizers, barrier creams, protective gloves, skin protection education, and
14 complex interventions (a combination of two or more of the interventions listed here) in preventing
15 OIHD in wet workers, comparing each intervention to an alternative intervention or to usual care
16 (workers regular skin care regime).

17 **Inclusion criteria**

18 ***Types of participants***

19 Any workers from healthcare (e.g. nurses, doctors and allied health professionals) and also different
20 wet work occupations (e.g. hairdressers, florists, catering workers, metal workers) that are at similar
21 risk of OIHD.

22 ***Types of intervention***

23 Studies that assessed the following interventions in the primary prevention of OIHD in wet workers at
24 the workplace and at home (before and after work):

25 -Use of moisturizers, for example high and low lipid content moisturizers.

26 -Barrier creams, for example barrier creams which may contain substances such as liquid paraffin
27 lotion, lanolin oil, silicone or hydrocarbon.

28 -Gloves (rubber and/or cotton).

29 -Education (e.g. seminars and training courses; face-to-face or online delivery).

30 ***Types of studies***

31 This review considered for inclusion any experimental study design including randomized controlled
32 trials, non-randomized controlled trials, quasi-experimental, and before and after studies.

33 **Types of outcomes**

34 Primary outcome measures included OIHD incidence and secondary outcome measures included
35 product evaluation and change of occupation because of OIHD versus staying in the occupation.

36 **Search strategy**

37 Published and unpublished literature in the English language was sought between 2004 and 2017.
38 The databases searched included: COCHRANE CENTRAL, MEDLINE, CINAHL, AMED, and
39 EMBASE. The search for unpublished studies included: Google Scholar, Open DOAR, and Robert
40 Gordon University's thesis database 'OPEN AIR'.

41 **Results**

42 There were no studies located that met the inclusion requirements of this review.

43 **Conclusion**

44 There is currently no evidence available to determine the effectiveness of interventions to prevent
45 OIHD amongst wet workers meeting this review's inclusion criteria.

46 **Keywords**

47 Contact dermatitis; hand dermatitis; occupational allergic contact dermatitis; occupational irritant;
48 occupational skin disease.

49 **Background**

50 **Definition, causes and epidemiology**

51 Occupational skin disease (OSD) accounts for one fifth of all diseases reported to the United Kingdom
52 (UK) Occupational Disease and Intelligence Network (ODIN) with Occupational Contact Dermatitis
53 (OCD) including both Occupational Irritant Hand Dermatitis (OIHD) and Occupational Allergic Contact
54 Dermatitis (OACD) representing the majority of those reported.¹ Occupational Irritant Hand Dermatitis
55 appears to be more frequent than OACD due to the different mechanism of skin damage.²

56 Occupational Irritant Hand Dermatitis is caused by a skin irritant applied to the skin for sufficient time
57 and in sufficient concentration, whereas OACD is caused by sensitizers penetrating the skin layers
58 and provoking a chain of immunological events which soon after (usually within seven days) cause
59 allergy.² The main causes of OIHD are the nature of the substance and the degree, duration and
60 frequency of exposure, as well as factors such as under-hydration or over-hydration of the barrier
61 layer of the skin which can determine the susceptibility of the individual.² The main signs of OIHD are
62 redness, swelling, blistering, flaking, cracking and itching.² Clinical investigation and diagnosis of OSD
63 includes medical examination, patch testing, prick testing, blood testing and skin biopsy.² The focus of
64 this review was on the prevention of OIHD as it is more prevalent than OACD in wet workers.

65

66 The UK's Health and Safety Executive (HSE) defines wet work as: '*...Prolonged or frequent contact*

67 *with water, particularly in combination with soaps and detergents, can cause dermatitis (e.g. a long time*
68 *spent washing up or frequent hand washing). 'Wet work' is the term used to describe such tasks in the*
69 *workplace...*^{3(para 1)}. Occupational Skin Disease constitutes a significant public health concern in
70 industrial countries as it is the most common occupational hazard⁴ with occupational hand dermatitis
71 being the most frequent work-related skin disease in many Western countries.⁵ It is therefore a major
72 occupational health concern in terms of clinical and economic consequences. For example it is
73 estimated that four million working days are lost every year due to OSD in the UK.¹ Work-related skin
74 and respiratory disease account for a significant part of the work-related ill-health (WRIH) of the UK.⁶
75 Several European and Asian countries, as well as the United States, also keep registers of OSD.
76 However, due to under-diagnosis and under-reporting of the disease, it has been difficult to evaluate
77 the actual international incidence as well as the prognosis of OSD.⁴

78
79 The evidence suggests that OSD is a significant problem amongst the working population, particularly
80 amongst healthcare workers (HCWs).⁷ Intact skin on the hands and forearms is a requirement for HCWs
81 undertaking certain roles as it reduces the risk of healthcare associated infection (HAI).⁸ In addition, a
82 number of healthcare associated tasks have the potential to result in OSD, some of which may be
83 severe and resistant to treatment.⁹ Consideration of HCWs skin and skincare is therefore important
84 both for patient and staff health and safety. The two most common causes of OSD are working with wet
85 hands and contact with soaps and cleaning materials.⁷ The Health and Occupation Research Network
86 (THOR) includes a scheme known as EPIDERM in which dermatologists record any new cases of OSD
87 they come across in the UK.⁷ Data available from EPIDERM between 2002 and 2013 show significant
88 variations in incidence rates of occupational dermatitis.⁷ High incidence is defined as >30 incidents per
89 100,000 workers per year.⁷ The five occupations with the higher rates between 2004 and 2013 were:
90 (i) florists (110 cases per 100,000 workers per year), (ii) hairdressers and barbers (88 cases per 100,000
91 workers per year), (iii) cooks (70 cases per 100,000 workers per year), (iv) beauticians (64 cases per
92 100,000 workers per year), and (v) metal working machine operatives (61 cases per 100,000 workers
93 per year).⁷ Other occupations with high incidence rates (over 30 new cases per 100,000 workers per
94 year) include dental practitioners, nurses, dental nurses and podiatrists.⁷ It is crucial to mention that the
95 data cited above concern the reported incidents of the UK which are restricted to more severe cases
96 and as such, are subject to a degree of underreporting.⁷ Similarly in 2001 a Freedom of Information
97 Request in the US Food and Drug Administration's Adverse Event Reporting System regarding adverse
98 reactions to popular alcohol-based hand rubs identified only one reported case attributed to the
99 product.⁸ Recognition of OSD differs in each country and OSD reporting is subject to diverse policies
100 and practices throughout the globe. Despite these existing differences, underreporting of OSD appears
101 to be a recognized and common theme.

102

103 **Impact**

104 Occupational-related skin problems (including OIHD) can cause long term ill-health and have adverse

105 career implications for all wet workers.²⁻⁷⁻¹⁰ For example there are certain occupational skin diseases
106 caused by specific substances which can result in chronic skin disease, increased risk of developing
107 allergic dermatitis, development of inflammatory conditions such as urticaria or even ulcerative and
108 degenerative skin diseases.² Furthermore, this can impact adversely on the treatment of patients and
109 also the cost to Health Services.¹ Reliable and continuous health surveillance for individuals at risk of
110 developing skin reactions is essential in terms of: (i) creating a framework for early detection of skin
111 problems, and (ii) controlling for the exposure to substances which have the potential to cause harm.²
112 Early intervention and assessment is crucial to achieve successful, long term outcomes for HCWs with
113 or without pre-existing skin conditions. Brown¹ identified the high prevalence of OCD in all industries in
114 the UK and acknowledges the health impact as well as the economic consequences. He encouraged
115 further evaluation of preventative measures in order to reduce the prevalence of OCD. In 2008 skin
116 diseases were listed as the second most common occupational health problem in Europe as published
117 in the European Risk Observatory report by the European Agency for Safety and Health at Work.
118 Occupational skin diseases were considered one of the most emerging risks related to the exposure to
119 chemical, physical and biological risk factors with high economic costs, calculated to be five billion euros
120 per year in the European Union (EU).¹¹

121

122 ***Intervention strategies***

123 Vocational rehabilitation is described as anything that assists an employee with a health condition or
124 disability to return to, stay in, or move into work.¹⁰ Extensive evidence supports that work is good for
125 health and that the benefits of work to health outweigh the risks of work as well as the effects of
126 worklessness and unemployment.¹⁰ Keeping employees healthy at work is a balance between the
127 health promotion and focus on work.¹⁰ Prevention strategies, for example compliance with health and
128 safety regulations and rehabilitation interventions, address and incorporate biopsychosocial factors to
129 support employees to return to or stay healthy in work.¹⁰ In occupations where there is high risk of OIHD
130 the prevention strategies are usually well defined. When substances have skin-damaging potential the
131 Control of Substances Hazardous to Health Regulations (COSHH) apply in the UK, and the employer
132 must make an assessment of the risks to any employee liable to exposure to a substance hazardous
133 to health.² Recognition and registration of skin disease on a national level depends heavily on the
134 standards and criteria used to recognize occupational disease in each of the countries within the EU. It
135 is therefore difficult to compare systems or information about the recognition of occupational diseases.
136 On a global level, the International Labour Organization (ILO) continues to provide guidance via
137 conventions and policies regarding coherent national occupational safety and health policies to promote
138 health and improve working conditions. Conventions particular to workplace skin exposures include the
139 application of procedures for recognition, notification and prevention.¹¹ Strategies to prevent OSD may
140 include automation of processes (depending on industry and occupation), replacement of the need for
141 employees to expose skin to irritants and/or replacement of dangerous substances (less toxic, less
142 irritant, less allergic).² Other strategies for prevention of OSD include changing the employee's

143 behavior, for example, encouraging changes to the frequency of hand washing, appropriate use of
144 personal protective equipment such as rubber gloves and/or cotton liners where indicated, use of barrier
145 creams, use of moisturizers and raising awareness of the risks of OSD.² Personal protective equipment
146 can vary in form, for example it can be gloves, aprons, overalls, hats, masks, safety boots etc.¹⁰
147 Protective gloves contain substances that can act as sensitizers to the skin. The HSE has provided
148 guidance on the selection of gloves.¹² Barrier creams are a topical preparation applied to the skin in
149 order to provide a barrier.² They often contain lanolin, paraffin, silicones or polyethylene glycols.¹⁰
150 Barrier creams are used to protect employees against work-related skin disease; however, occasionally
151 the substances contained in these creams can themselves cause sensitization.²⁻¹⁰ Moisturizers, or
152 emollients, are used for regenerative skin care before, during (when indicated and when they do not
153 compromise the employee's task) and after work.²

154

155

156 ***Systematic Reviews***

157 One systematic review has been published on the prevention of OIHD amongst wet workers, and two
158 other systematic reviews have addressed the management of skin disease in the workplace. Bauer et
159 al.¹⁴ conducted a Cochrane review of Randomized Controlled Trials (RCTs) published between 2003
160 and 2011. Four international studies met the inclusion criteria. The overall review produced positive
161 findings in respect of primary prevention of OIHD: the beneficial effects of using barrier creams and
162 emollients, and an absence of harmful effects. None of the RCTs identified any problems with the
163 efficacy of glove use. Due to the lack of statistical significance that emerged from the review, Bauer et
164 al.¹⁴ concluded that there is a need for larger studies to determine if primary prevention is effective and,
165 if so, which is the best preventive measure. The main limitations of the review were the: (i) limited
166 numbers of RCTs; (ii) methodological weaknesses of the studies identified for example short-term
167 studies and the application of interventions restricted to healthy people; and (iii) complete absence of
168 studies which support or refute the use of gloves as primary prevention. The fundamental forms of
169 prevention that emerged from the review were the change of workers' behavior by use of creams,
170 reduction of hand washing as well as refraining from wet work.

171 Saary et al.¹⁵ conducted a systematic review of international studies published between 1960 and 2003
172 to provide the Workplace Safety and Insurance Board (WSIB) of Ontario, Canada with evidence-based
173 recommendations regarding treatment decisions for OCD.¹⁵ Forty-nine studies conducted in a range of
174 countries met the inclusion criteria. Barrier creams containing dimethicone or perfluoropolyethers,
175 cotton liners, and softened fabrics prevented irritant contact dermatitis (ICD). Lipid-rich moisturizers
176 both prevented and treated irritant CD. Topical skin protectant and quaternium 18 bentonite
177 (organoclay) prevented dermatitis. Diethylenetriamine pentaacetic acid (chelator) cream prevented
178 nickel, chrome, and copper dermatitis. Potent or moderately potent steroids effectively treated allergic
179 contact dermatitis (ACD). There were no macrolide immunomodulator trials that met inclusion criteria.¹⁵
180 A limited number of interventions effectively prevented or treated OICD and OACD, but well-controlled,

181 outcome-blinded studies, particularly in the area of ACD prevention were recommended.¹⁵
182 Smedley et al.¹⁶ performed a systematic review of 11 international RCT's on the management of
183 occupational dermatitis focussing on HCWs. Whilst a number of conclusions were drawn, five in
184 particular can be regarded as the most relevant to the proposed review. First, HCWs should seek early
185 treatment for dermatitis. Second, in severe cases of acute dermatitis, work adjustments should be
186 applied. Third, HCWs with dermatitis should follow a particular skin programme (for hand hygiene and
187 hand care). Fourth, the need for further research on the risk of HCWs to transfer infection to patients is
188 evident. Fifth, it remains unclear to what extent health surveillance is effective in reducing dermatitis.
189 Two key limitations of the literature were identified by Smedley et al.¹⁶ The first was non-statistical
190 significance of the findings (large studies failed to determine whether primary prevention is helpful) and
191 therefore, a comprehensive review that includes evidence from other quantitative study designs may
192 be useful in synthesizing a broad range of evidence. The second was a lack of intervention uniformity.
193

194 Despite a lack of robust evidence regarding the prevention of OIHD provided by previous systematic
195 reviews, useful guidance can be drawn by conducting a further systematic review as initial literature
196 searching has identified studies¹⁷⁻¹⁸ conducted since the publication date of these previous reviews that
197 might be suitable for inclusion in a new synthesis. Due to the emergence of recent literature, and the
198 specific nature of the previous systematic reviews conducted on this topic¹⁴⁻¹⁵⁻¹⁶ there is a need to: (i)
199 identify and appraise a broader range of literature, including recent intervention studies, focused on the
200 prevention of OIHD amongst wet workers, and (ii) focus on the strategy and effectiveness of measures
201 to prevent OIHD amongst HCWs. The aim of this systematic review was therefore to identify findings
202 from RCTs and other quantitative study designs that could contribute to the evidence of the
203 effectiveness of interventions aimed at preventing OIHD. The objectives, inclusion criteria and methods
204 of analysis for this review were specified in advance in a previously published protocol.¹⁹

205

206 **Objective**

207

208 The objective of this quantitative systematic review was to identify, appraise and synthesize the best
209 available evidence on the effectiveness of moisturizers, barrier creams, protective gloves, skin
210 protection education, and complex interventions (a combination of two or more of the interventions listed
211 here) in preventing OIHD in wet workers, comparing each intervention to an alternative intervention or
212 to usual care (workers regular skin care regime).The specific review question was: What is the
213 effectiveness of moisturizers, barrier creams, protective gloves, skin protection education, and complex
214 interventions in preventing OIHD in wet workers?

215 **Inclusion criteria**

216 ***Types of participants***

217 In keeping with previous systematic reviews in this area¹⁴⁻¹⁵⁻¹⁶ participants included any workers from
218 healthcare (e.g. nurses, doctors and allied health professionals) and also different wet work occupations
219 (e.g. hairdressers, florists, catering workers, metal workers) that are at similar risk of OIHD¹¹ due to, for
220 example, frequent hand washing, skin contact with substances contained in soaps and/or hand gels
221 and/or prolonged use of gloves. We intended to include primary prevention studies where participants
222 had no pre-existing skin conditions. We also intended to include mixed population (pre-existing and no
223 pre-existing skin conditions) studies where the data for participants without pre-existing skin conditions
224 could be extracted separately.

225

226 ***Types of intervention***

227 This quantitative systematic review considered studies that measured the effectiveness of the following
228 interventions in the primary prevention of OIHD in wet workers at the workplace and at home (before
229 and after work):

- 230 • use of moisturizers, for example high and low lipid content moisturizers
- 231 • barrier creams, for example barrier creams which may contain substances such as liquid
232 paraffin lotion, lanolin oil, silicone or hydrocarbon
- 233 • gloves (rubber and/or cotton) and
- 234 • education (e.g. seminars and training courses; face-to-face or online delivery).

235 Due the variability in regimens, any dosage/intensity of preventive intervention for any length of
236 time were considered for inclusion in this review including complex interventions that combined
237 more than one of the above interventions.

238

239 ***Types of comparator***

240 This review considered studies that compared one type of intervention to another. Studies that
241 compared an intervention to a control group who did not receive any intervention were also considered.

242

243 ***Types of studies***

244 This review considered for inclusion any experimental study design including randomized controlled
245 trials, non-randomized controlled trials, quasi-experimental, and before and after studies.

246

247 ***Types of outcomes***

248 Primary outcome measures included:

249 OIHD incidence, defined as:

- 250 • The proportion of wet workers who have developed any signs or symptoms of OIHD incidence

251 diagnosed by the investigator, a health professional or the participants themselves.

252

253 OIHD severity, defined as:

254 • Clinical evaluation (severity/improvement) of the signs or symptoms either by the investigator
255 or the participant. Any widely accepted clinical assessment or self-report measure was considered for
256 inclusion, such as questionnaires and clinical examinations of hands,²⁰⁻²³ telephone interviews and
257 questionnaires based on the Nordic Occupational Skin Questionnaire (NOSQ-2002),²⁴ self-
258 administered questionnaires.²⁵

259 • Adverse outcomes (e.g. infections, severe irritation or allergy to products applied in the studies)
260 assessed by the participants and/or clinicians and/or outcome assessors reported in the studies.

261 Secondary outcome measures included:

262 • Product evaluation (proportion of participants satisfied with the products given in the study
263 including cosmetic, preventive and therapeutic properties of the products). Any information
264 which was recorded in the studies that rated the quality of the products was considered as
265 means of measurement either from the participants, or the clinicians or other outcome
266 assessors. Product evaluation recorded in studies would provide an insight into any changes
267 to participants' symptoms and is therefore considered a means of measuring product
268 effectiveness.¹⁴

269 • Change of occupation because of OIHD versus staying in the occupation that may have been
270 recorded in the studies, where the reason for changing occupation has been clearly stated as OIHD.

271

272 **Search strategy**

273 Published and unpublished literature in the English language was sought between 2004 and 2017.

274 This search covered the period employed by Bauer et al.¹⁴ up to the present day as well as the period
275 since the HSE guidance note on skin disease was last amended. The medical guidance note titled
276 'Medical aspects of occupational skin disease'² released from the UK HSE in 1998 which has been re-
277 printed with amendments most recently in 2004 is the most pertinent guideline on skin disease in the
278 UK. The HSE although being a UK enforcing agency is internationally recognized and collaborates
279 closely with various European and international bodies regarding occupational health and safety. A
280 three-step search strategy was utilized in eight databases. An initial limited search of MEDLINE and
281 CINAHL was undertaken using the initial keywords: 'Dermatitis' 'Occupational Health' and
282 'Occupational Skin Disease'. This was followed by analysis of the text words contained in the title and
283 abstract, and of the index terms used to describe the articles. A second search using all identified
284 keywords and index terms was then undertaken across all included databases: COCHRANE
285 CENTRAL, MEDLINE, CINAHL, AMED, EMBASE. The search for unpublished studies included:
286 Google Scholar, Open DOAR, and Robert Gordon University's thesis database 'OPEN AIR'. See

287 Appendix I for the detailed search strategy used in all databases. Thirdly, the reference list of all
288 identified reports and articles was searched for additional studies.
289 The search resulted in literature on occupations not relevant to this review. Initial screening identified
290 which occupations were included in these studies and only included for further screening those who
291 were considered wet workers.

293 **Method of the review**

294 As no studies were located that met the eligibility criteria for this review, assessment of
295 methodological quality, data extraction and synthesis were not performed.

297 **Results**

298 *Description of studies*

299 Following the comprehensive electronic database search, a total of 5418 relevant titles were obtained
300 by the authors; 1854 duplicates were removed. Following title and abstract screening of the remaining
301 articles (n=3564), 3508 were excluded at that stage. Fifty six full-text papers were retrieved for further
302 review. Of these fifty six articles, the reviewers excluded all fifty six after the full text review as they did
303 not meet the inclusion criteria. For example some studies ^{26, 27, 28} were excluded due to the population
304 not being wet workers. The majority of the remainder did not meet the inclusion criteria of being
305 prevention studies due to recruiting mixed populations of participants with and without pre-existing
306 skin conditions; on close inspection it was apparent that data from participants without pre-existing
307 skin conditions could not be extracted separately. A common theme that was observed during closer
308 inspection of the excluded studies was the variety of methods used for reporting and scoring the
309 existence and severity of pre-existing skin conditions. The excluded studies with the reasons for
310 exclusion are documented in Appendix II. Figure 1 outlines the different stages of identification and
311 retrieval of relevant studies for inclusion in this systematic review.

313 **Figure 1: Flow diagram for search results**

315 **Discussion**

316 Despite finding a number of studies³⁰⁻³¹⁻³²⁻³³⁻³⁴⁻³⁵⁻³⁶⁻³⁷⁻³⁸⁻³⁹⁻⁴⁰ with published evidence of interventions
317 focused on the effectiveness of interventions for the prevention of occupational skin disease we were
318 unable to extract and analyse separately the data from participants without pre-existing skin
319 conditions in order to address the review objective of exploring the effectiveness of interventions

320 aimed at preventing (rather than reducing) incidence of OIHD. Pre-existing skin conditions provide a
321 risk factor for developing further skin irritation and potentially skin disease.⁴¹ Although skin
322 improvements/changes were identified in the majority of the intervention groups in the excluded
323 studies, it was not possible to ascertain whether they were attributed to the effectiveness of the
324 intervention at primary prevention or its effectiveness in reducing pre-existing symptoms. The
325 evaluation of the severity of skin disease amongst participants at baseline varied between the
326 excluded studies.³⁰⁻³¹⁻³²⁻³³⁻³⁴⁻³⁵⁻³⁶⁻³⁷⁻³⁸⁻³⁹⁻⁴⁰ For example participants in a study conducted by Held et al⁴²
327 which tested an educational intervention, employed questionnaires, clinical examination of the hands,
328 measurement of transdermal water loss (TEWL) and patch testing for evaluation. Despite the fact that
329 the study showed promising results from the use of an educational programme, the decrease in skin
330 symptoms occurring after the intervention was not statistically significant. In before-after studies,
331 although tested tools such as the hand eczema severity index (HECSI)⁴³ were used to evaluate the
332 skin of the participants, it was frequently based on self-reported responses³⁰⁻³¹⁻³²⁻³³⁻³⁴⁻³⁵⁻³⁶⁻³⁷⁻³⁸⁻³⁹⁻⁴⁰
333 (answered on questionnaires at baseline and follow-up) and not always confirmed by visual skin
334 checks from truly blinded experts. It is evident that these studies³⁰⁻³¹⁻³²⁻³³⁻³⁴⁻³⁵⁻³⁶⁻³⁷⁻³⁸⁻³⁹⁻⁴⁰ have not
335 purely focused on primary prevention; rather they have included participants with and without pre-
336 existing skin conditions. It is therefore not possible to conclude from their findings whether the
337 interventions prevent OIHD from developing or only prevent it from worsening in pre-existing cases.
338 Separate subgroup analyses based on the presence or absence of pre-existing skin conditions would
339 have allowed data from these studies to be included in the review and we strongly recommend that
340 researchers include subgroup analyses in future studies.

341 However, it is important to note that studies which investigated the effectiveness of interventions
342 aimed at preventing skin disease in nursing, baking and hairdressing apprentices³⁰⁻⁴¹⁻⁴⁴ discussed and
343 analysed the prevalence of skin symptoms before and during training and concluded that existing skin
344 symptoms was a risk factor for developing further irritations. Suggestions for either excluding or
345 analysing separately participants with pre-existing skin symptoms are essential to evaluating the true
346 effectiveness of interventions aimed at primary prevention of OIHD. Homogeneity in clinically
347 assessing and evaluating skin severity may lead to improved outcomes that may be transferred
348 across wet work professions.

349 Intervention studies involving different wet work occupations showed promising results despite the
350 fact that they included mixed populations of participants. It is evident that more research is needed to
351 further investigate compliance after such educational interventions in different work settings.⁴⁵ This
352 might have an impact on preventing OIHD as well as controlling skin symptoms for those wet workers
353 who have pre-existing skin symptoms in the long term.

354 The protocols of two large RCTs^{46,47} were identified that are presumably currently in progress. The
355 first study protocol⁴⁶, a cluster RCT in UK, aims to test whether a web-based behavioral change
356 program coupled with provision of hand moisturisers can reduce the prevalence of hand dermatitis
357 after one year when compared to standard care in nurses at high risk of OIHD. The study plans to

358 recruit mixed populations of participants; student nurses with a history of atopic disease and allergies
359 and nurses working in intensive care units who are at increased risk of hand dermatitis due to the
360 nature of their work (wet work). The second study protocol⁴⁷, also a cluster RCT, taking place in
361 Netherlands, focuses on nurses performing wet work. The study aims to assess the effectiveness of
362 the intervention which consists of the facilitation of creams being available at the wards combined with
363 the continuous electronic monitoring of their consumption with regular feedback on skin care
364 performance. This study will also recruit mixed population participants.

365 Although this is an 'empty review' where no studies were located meeting *a priori* inclusion criteria for
366 this systematic review the authors strongly believe that benefits can be drawn from the gaps in the
367 current evidence base.

368 **Limitations of the review**

369 The lack of evidence may have been a result of the search itself. The search was restricted to English
370 language papers only. No primary prevention studies published to date have provided evidence of
371 effectiveness of any types of interventions where data from mixed populations (participants with pre-
372 existing and without pre-existing skin conditions) were analysed separately. Although the search
373 terms used were developed in consultation with an occupational health physician specialised in skin
374 disease at the workplace as well as a librarian, it is well known that the literature in this area is not
375 standardized and difficult to locate. There is therefore a chance that literature was not captured in part
376 due to these reasons. Our initial literature searching during protocol development suggested that
377 there would be literature to include in the review; however, in order to address the specific review
378 question of interest (primary prevention of OIHD) we employed rigorous inclusion/exclusion which all
379 studies, on close inspection, failed to meet. Our scoping search did find three previous systematic
380 reviews, suggesting that there is literature on this topic. However, one of these reviews was published
381 before our lower date range¹⁵, one focused on the management of OIHD¹⁶, which by definition
382 includes participants with pre-existing skin conditions, and the one which did focus on prevention¹⁴
383 included studies of mixed populations, thereby not fulfilling the definition of primary prevention. It is
384 therefore clear that there is an abundance of evidence in relation to preventing OIHD from worsening
385 or from recurring, but there is currently a lack of evidence relating to the primary prevention of OIHD,
386 and high quality primary research studies are urgently required.

387 It is possible that amending the inclusion criteria might have located studies for inclusion, for example
388 including non-wet workers, mixed populations, or non-experimental study designs. However, we had
389 identified a need to explore the evidence on the effectiveness of primary prevention in OIHD in wet
390 workers from high quality studies at low risk of bias. Adhering to the a-priori protocol has enabled us
391 to highlight the lack of evidence and urgent need for this to be addressed by the scientific community
392 working in this field.

393

394

395 **Conclusion**

396 There is currently no evidence available for meta-analysis to determine the effectiveness of
397 interventions in preventing OIHD in wet workers.

398

399 ***Implications for practice***

400 There is currently no evidence on the prevention of OIHD in wet workers due to the lack of literature
401 available which assessed the effectiveness of moisturizers, barrier creams, protective gloves, skin
402 protection education and complex interventions (a combination of two or more of the interventions
403 listed) meeting this review's inclusion criteria. No primary prevention studies were found where all
404 participants had no pre-existing skin conditions. With regards to the studies identified with mixed
405 populations (pre-existing and no pre-existing skin conditions) they were all excluded as the data for
406 participants without pre-existing skin conditions could not be extracted separately. Therefore, no
407 conclusive recommendations can be made regarding the effectiveness of interventions in preventing
408 OIHD in wet workers without pre-existing skin conditions as all the studies inspected analysed mixed
409 populations of participants (with and without pre-existing skin conditions).

410 ***Implications for research***

411 An evidence gap has been identified in relation to the effectiveness of interventions aimed at primary
412 prevention of OIHD in wet workers without pre-existing skin conditions Quantitative research studies
413 are urgently required to identify this evidence and should either investigate participants without pre-
414 existing skin conditions or, if including a mixed population, should present separate analysis for
415 participants without pre-existing conditions. There is also a need for researchers to reach consensus
416 on methods of assessing severity of skin conditions to enable synthesis of findings from future
417 studies.

418 **Conflict of interest**

419 The authors declare that there were no conflicts of interest.

420 **Acknowledgements**

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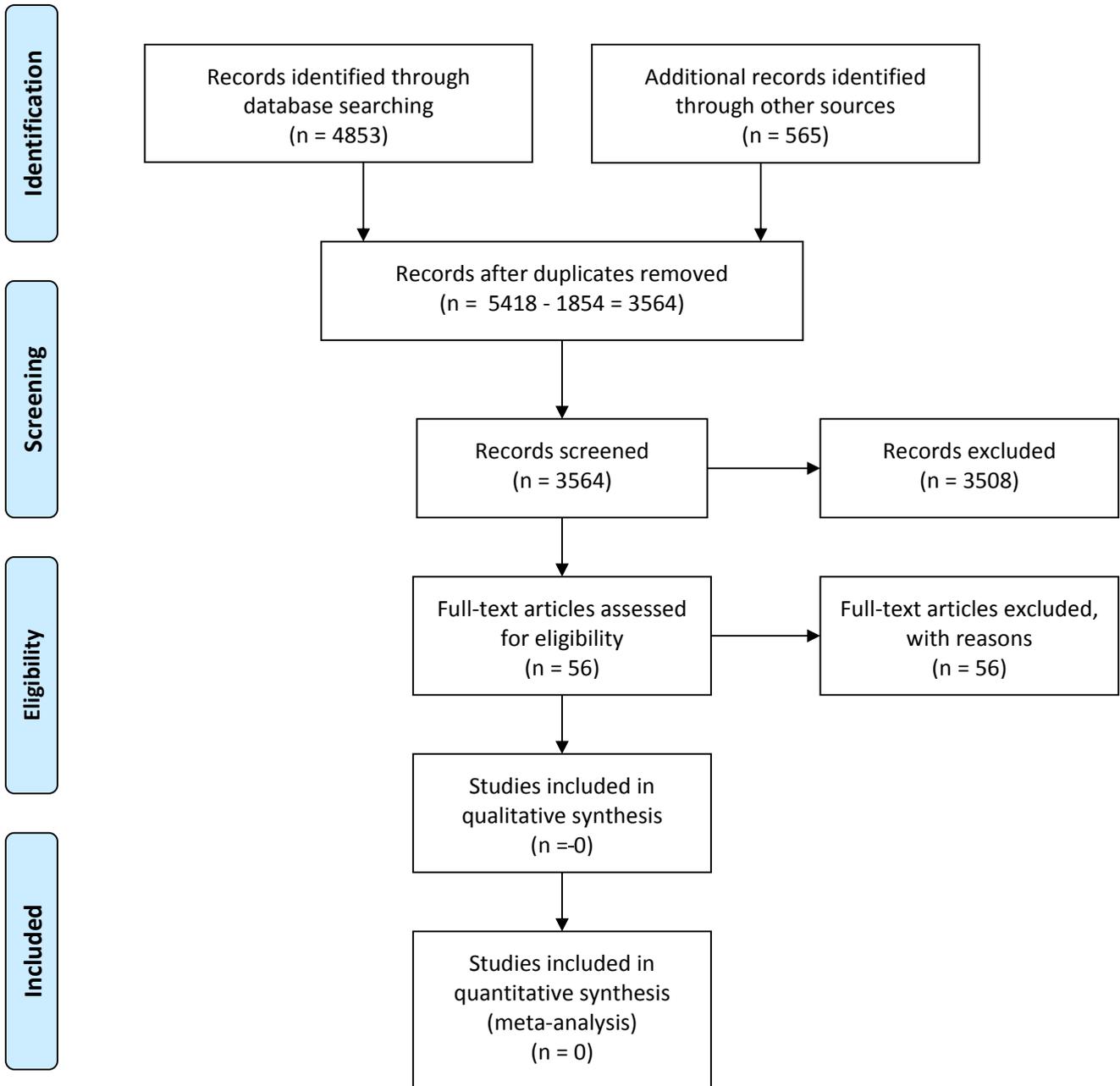
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Figure 1: Flow diagram for search results



557 **Appendix I: Search Strategy**

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559 **MEDLINE (EBSCOhost), 2004 to 2017, date of last search 04.01.2018 (all fields)**

1	"Hand" [MeSH] OR "hand"
2	"Skin" [MeSH] OR "skin"
3	"Epidermis" [MeSH] OR "epiderm"
4	"Dermis" [MeSH] OR "derm"
5	2 OR 3 OR 4
6	"Disease" [MeSH] OR "disease"
7	"Disorder"
8	"Condition"
9	6 OR 7 Or 8
10	"Work" [MeSH] OR "work"
11	"Occupations" [MeSH] OR "occupation"
12	"Job"
13	10 OR 11 OR 12
14	1 AND 5 AND 9 AND 13

560

561 **Embase (Ovid) 2004 to 2017, date of last search 04.01.2018 (all fields)**

1	Hand/ OR hand*.mp
2	Skin/ OR skin*.mp
3	Epidermis/ OR epiderm*.mp
4	Dermis/ OR derm*.mp
5	2 OR 3 OR 4
6	Disease/ OR disease*.mp
7	Disorder* .mp
8	Condition* .mp
9	6 OR 7 OR 8
10	Work/ OR work*.mp
11	Occupation/ OR occupation*.mp
12	Job* .mp
13	10 OR 11 OR 12
14	1 AND 5 AND 9 AND 13

562

563 **AMED 2004 to 2017, date of last search 06/01/2018 (all fields)**

1	((MH) "Hand" OR "hand")
2	((MH) "Skin" OR "skin")
3	((MH) "Epidermis" OR "epiderm")
4	((MH) "Dermis" OR "derm")
5	2 OR 3 OR 4
6	((MH) "Disease" OR "disease")
7	"Disorder"

8	"Condition"
9	6 OR 7 OR 8
10	((MH) "Work" OR "work")
11	((MH) "Occupations" OR "occupation")
12	"Job"
13	10 OR 11 OR 12
14	1 AND 5 AND 9 AND 13

564

565 **CINAHL 2004 to 2017, date of last search 06/01/2018 (all fields)**

1	((MH) "Hand") OR "hand"
2	((MH) "Skin") OR "skin"
3	((MH) "Epidermis") OR "epiderm"
4	((MH "Dermis") OR "derm"
5	2 OR 3 OR 4
6	((MH "Disease" OR "disease"
7	"Disorder"
8	"Condition"
9	6 OR 7 OR 8
10	((MH "Work") OR "work"
11	((MH "Occupations") OR "occupation"
12	"Job"
13	10 OR 11 OR 12
14	1 AND 5 AND 9 AND 13

566

567 **Cochrane Central 2004 to 2017, date of last search 06/01/2018 (all fields)**

1	((MeSH) [Hand]) AND ((MeSH) [skin]) OR "dermis"
2	((MeSH) [Disease] OR "condition"
3	((MeSH) [Work] OR ((MeSH) [occupation])

568

569 **GOOGLE Scholar 2004 to 2017, date of last search 11/01/2018**

570 Search terms: (occupational skin disease AND wet workers AND intervention)

571 <https://scholar.google.co.uk/scholar?q=occupational+skin+disease+AND+wet+workers+AND+interve>
572 [ntion&hl=en&as_sdt=1%2C5&as_ylo=2016&as_yhi=2017](https://scholar.google.co.uk/scholar?q=occupational+skin+disease+AND+wet+workers+AND+interve&hl=en&as_sdt=1%2C5&as_ylo=2016&as_yhi=2017)

573 Search terms: (dermatitis AND wet workers AND intervention)

574 https://scholar.google.co.uk/scholar?q=dermatitis+AND+wet+workers+AND+intervention&hl=en&as_s
575 [dt=1%2C5&as_ylo=2016&as_yhi=2017](https://scholar.google.co.uk/scholar?q=dermatitis+AND+wet+workers+AND+intervention&hl=en&as_sdt=1%2C5&as_ylo=2016&as_yhi=2017)

576

577 **Grey Literature Search Strategy 2004 to 2017, date of last search 11/01/2018**

578 Robert Gordon University's thesis database **OpenAIR**

579 Search terms: (occupational skin disease AND wet workers AND intervention)

580 Search terms: (dermatitis AND wet workers AND intervention)

581 All excluded

582

583

584 **OpenDOAR 2004 to 2017, date of last search 11/01/2018**

585 Search terms: (occupational skin disease AND wet workers AND intervention)

586 Search terms: (dermatitis AND wet workers AND intervention)

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602 **Appendix II: Excluded studies**

603 Aalto-Korte K, Ackermann L, Henriks-Eckerman ML, Välimaa J, Reinikka-Railo H, Leppänen E, *et al.*
604 1,2-Benzisothiazolin-3-One in Disposable Polyvinyl Chloride Gloves for Medical use. Contact dermatitis
605 2007;57(6):365-370.

606 **Reason for exclusion: type of population (not wet workers) did not match the inclusion criteria,**
607 **intervention and comparison did not match the inclusion criteria.**

608 Abramovits W, Granowski P. Innovative management of severe hand dermatitis. *Dermatol Clin*
609 2010;28(3):453-465.

610 **Reason for exclusion: type of population (not wet workers) did not match the inclusion criteria,**
611 **intervention and comparison did not match the inclusion criteria.**

612 Agthe N, Terho K, Kurvinen T, Routamaa M, Peltonen R, Laitinen K, *et al.* Microbiological efficacy and
613 tolerability of a new, non-alcohol-based hand disinfectant. *Infect Control Hosp Epidemiol*
614 2009;30(7):685-690.

615 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin**
616 **conditions) did not match the inclusion criteria, intervention and comparison did not match the**
617 **inclusion criteria.**

618 Ahmed-Lecheheb D, Cunat L, Hartemann P, Hautemanière A. Prospective observational study to
619 assess hand skin condition after application of alcohol-based hand rub solutions. *Am J Infect Control*
620 2012;40(2):160-164.

621 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin**
622 **conditions) did not match the inclusion criteria, intervention and comparison did not match the**
623 **inclusion criteria.**

624 Al-Niaimi F, Chiang YZ, Chiang YN, Williams J. Latex allergy: assessment of knowledge, appropriate
625 use of gloves and prevention practice among hospital healthcare workers. *Clin Exp Dermatol*
626 2013;38(1):77-80.

627 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin**
628 **conditions) did not match the inclusion criteria, intervention and comparison did not match the**
629 **inclusion criteria.**

630 Antelmi A, Young E, Svedman C, Zimerson E, Engfeldt M, Foti C, *et al.* Are gloves sufficiently protective
631 when hairdressers are exposed to permanent hair dyes? An in vivo study. *Contact dermatitis*
632 2015;72(4):229-236.

633 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin**
634 **conditions) did not match the inclusion criteria, intervention and comparison did not match the**

635 **inclusion criteria.**

636 Apfelbacher CJ. No difference in skin condition between workers exposed and not exposed to glove
637 occlusion in a semiconductor company. *Br J Dermatol* 2015;172(4):855-856.

638 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin**
639 **conditions) did not match the inclusion criteria, intervention and comparison did not match the**
640 **inclusion criteria.**

641 Apfelbacher CJ, Soder S, Diepgen TL, Weisshaar E. The impact of measures for secondary individual
642 prevention of work-related skin diseases in health care workers: 1-year follow-up study. *Contact*
643 *dermatitis* 2009;60(3):144-149.

644 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin**
645 **conditions) did not match the inclusion criteria.**

646 Arbogast JW, Fendler EJ, Hammond BS, Cartner TJ, Dolan MD, Ali Y, *et al.* Effectiveness of a hand
647 care regimen with moisturizer in manufacturing facilities where workers are prone to occupational irritant
648 dermatitis. *Dermatitis* 2004;15(1):10-17.

649 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin**
650 **conditions) did not match the inclusion criteria.**

651 Baumeister T, Weistenhöfer W, Drexler H, Kütting B. Prevention of work-related skin diseases:
652 Teledermatology as an alternative approach in occupational screenings. *Contact dermatitis*
653 2009;61(4):224-230.

654 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin**
655 **conditions) did not match the inclusion criteria, intervention and comparison did not match the**
656 **inclusion criteria.**

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658 emollient-impregnated gloves to promote skin health and prevent the transmission of multidrug-
659 resistant organisms in a surgical intensive care unit. *Infect Control Hosp Epidemiol* 2010;31(5):491-497.

660 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin**
661 **conditions) did not match the inclusion criteria, intervention and comparison did not match the**
662 **inclusion criteria.**

663 Bregnhøj A, Menné T, Johansen JD, Søsted H. Prevention of hand eczema among Danish hairdressing
664 apprentices: An intervention study. *Occup Environ Med* 2012;69(5):310-316.

665 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin**
666 **conditions) did not match the inclusion criteria.**

667 Brown T, Rushton L, Williams HC, English JSC. Intervention development in occupational research: An
668 example from the printing industry. *Occup Environ Med* 2006;63(4):261-266.

669 **Reason for exclusion: type of population (not wet workers) did not match the inclusion criteria.**

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671 and glove use in Hong Kong. *Journal of Clinical Nursing* 2011;20(9-10):1319-1328.

672 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin
673 conditions) did not match the inclusion criteria, intervention and comparison did not match the
674 inclusion criteria.**

675 Clemmensen KKB, Randbøll I, Ryborg MF, Ebbenhøj NE, Agner T. Evidence-based training as primary
676 prevention of hand eczema in a population of hospital cleaning workers. *Contact dermatitis*
677 2015;72(1):47-54.

678 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin
679 conditions) did not match the inclusion criteria, intervention and comparison did not match the
680 inclusion criteria.**

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682 *AORN J* 2005;81(1):157-166.

683 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin
684 conditions) did not match the inclusion criteria, intervention and comparison did not match the
685 inclusion criteria.**

686 Dehdasthi A, Khavanin A. Prevention of skin exposure to metal working fluid in a tool manufacturing
687 plant: An intervention approach. *Dermatitis* 2011;22(5):307.

688 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin
689 conditions) did not match the inclusion criteria, intervention and comparison did not match the
690 inclusion criteria.**

691 Dulon M, Pohrt U, Skudlik C, Nienhaus A. Prevention of occupational skin disease: a workplace
692 intervention study in geriatric nurses. *Br J Dermatol* 2009;161(2):337-344.

693 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin
694 conditions) did not match the inclusion criteria.**

695 Flyvholm M, Mygind K, Sell L, Jensen A, Jepsen KF. A randomised controlled intervention study on
696 prevention of work related skin problems among gut cleaners in swine slaughterhouses. *Occup Environ
697 Med* 2005;62(9):642-649.

698 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin
699 conditions) did not match the inclusion criteria.**

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701 surgical and hygienic alcohol-based hand rubs. *J Hosp Infect* 2006;63(3):281-288.

702 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin**
703 **conditions) did not match the inclusion criteria, intervention and comparison did not match the**
704 **inclusion criteria.**

705 Held E, Wolff C, Gyntelberg F, Agner T. Prevention of work-related skin problems in student auxiliary
706 nurses. An intervention study. Contact Dermatitis 2001;44:297-303.

707 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin**
708 **conditions) did not match the inclusion criteria.**

709 Held E, Mygind K, Wolff C, Gyntelberg F, Agner T. Prevention of work related skin problems an
710 intervention study in wet work employees. Occup Environ Med 2002;59(8):556-561.

711 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin**
712 **conditions) did not match the inclusion criteria.**

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714 protective gloves among hairdressers. Contact dermatitis 2012;66(s2):48.

715 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin**
716 **conditions) did not match the inclusion criteria, intervention and comparison did not match the**
717 **inclusion criteria.**

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719 2012

720 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin**
721 **conditions) did not match the inclusion criteria.**

722 Jungbauer FHW, Van Der Harst JJ, Groothoff JW, Coenraads PJ. Skin protection in nursing work:
723 promoting the use of gloves and hand alcohol. Contact dermatitis 2004;51(3):135-140.

724 **Reason for exclusion: the objective of this study did not match the review objective.**

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726 care workers. Medsurg Nursing: Official Journal Of The Academy Of Medical-Surgical Nurses
727 2007;16(4):247-252.

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729 **conditions) did not match the inclusion criteria, intervention and comparison did not match the**
730 **inclusion criteria.**

731 Kutting B, Baumeister T, Weistenhöfer W, Pfahlberg A, Uter W, Drexler H. Effectiveness of skin
732 protection measures in prevention of occupational hand eczema: results of a prospective randomized
733 controlled trial over a follow-up period of 1 year. Br J Dermatol 2010;162(2):362-370.

734 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin**

735 **conditions) did not match the inclusion criteria.**

736 Kwok T, Arrandale V, Skotnickigrant S. Repeated mechanical trauma to the hands: The use of anti-
737 impaction gloves for treatment and return to work. *Dermatitis* 2009;20(5):278-283.

738 **Reason for exclusion: type of population (not wet workers) did not match the inclusion criteria,**
739 **intervention and comparison did not match the inclusion criteria.**

740 Loffler H, Bruckner T, Diepgen T, Effendy I. Primary prevention in health care employees: a prospective
741 intervention study with a 3-year training period. *Contact dermatitis* 2006;54(4):202-209.

742 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin**
743 **conditions) did not match the inclusion criteria.**

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745 *Dermatol* 2011;174(3):654-656.

746 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin**
747 **conditions) did not match the inclusion criteria, intervention and comparison did not match the**
748 **inclusion criteria.**

749 Lysdal SH, Johansen JD, Flyvholm MA, Søsted H. A quantification of occupational skin exposures and
750 the use of protective gloves among hairdressers in Denmark. *Contact dermatitis* 2012;66(6):323-334.

751 **Reason for exclusion: type of population (mixed population, with and without pre-existing skin**
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