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Physical health issues in adults with severe or profound intellectual and motor disabilities: a systematic review of cross-sectional studies

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Abstract

Background People with severe or profound intellectual and motor disabilities (SPIIMD) encounter several risk factors associated with higher mortality rates. They are also likely to experience a cluster of health problems related to the severe brain damage/dysfunction. In order to earlier detect physical health problems in people with SPIIMD, first of all, knowledge regarding the prevalence of physical health problems is necessary. The aim of this systematic review was to methodically review cross-sectional studies on the prevalence of various types of physical health problems in adults with SPIIMD.
Method MedLine/PubMed, CINAHL, Embase, PsycINFO and Web of Science were searched for studies published between 2004 and 2015. The quality of the incorporated studies was assessed utilising an adjusted ‘risk of bias tool’ for cross-sectional studies. To estimate the prevalence of the health problems, the proportion and corresponding confidence interval were calculated. A random effect meta-analysis was performed when at least three studies on a specific health problem were available.
Results In total, 20 studies were included and analysed. In the meta-analysis, a homogeneous prevalence rate of 70% (CI 65–75%) was determined for epilepsy. Heterogeneous results were ascertained in the meta-analysis for pulmonary/respiratory problems, hearing problems, dysphagia, reflux disease and visual problems. For the health problems identified in two studies or in a single study, the degree of evidence was low. As expected, higher prevalence rates were found in the current review compared with people with ID for visual problems, epilepsy and spasticity.
Conclusion This review provides an overview of the current state of the art research on the prevalence of health problems in adults with SPIIMD. There is a substantial need for comprehensive epidemiological data in order to find clusters of health problems specific
for people with SPIMD. This would provide insight into the excess morbidity associated with SPIMD.

**Keywords** adults, physical health, review, severe or profound intellectual and motor disabilities, severe or profound intellectual disabilities

**Background**

People experiencing severe or profound intellectual and motor disabilities (SPIMD) are more likely to have a number of specific health needs; therefore, they represent a vulnerable group. This population has two key characteristics: (1) severe or profound intellectual disability (ID) and (2) profound motor disability manifesting in an inability to move independently. The majority of people with SPIMD additionally experience sensory impairments and physical health problems (Nakken & Vlaskamp 2007). Research in the Netherlands indicates a population size of a maximum of 9639 adults with SPIMD (Vugteveen et al. 2014).

People with SPIMD encounter several risk factors associated with higher mortality rates such as a lower IQ, non-ambulation, poor motor skills, inability to feed oneself, poor communication and self-help limitations. They are likely to gradually have different patterns of health problems than those with a milder ID (Sutherland et al. 2002; Hayden 1998) and suffer more often from multimorbidity (Hermans & Evenhuis 2014). Furthermore, they frequently experience a cluster of health problems related to the severe brain damage/dysfunction such as dysphagia, epilepsy, spasticity, reflux disease, hearing impairment and visual impairment. Moreover, they have an increased risk for polypharmacy and secondary health problems (Hermans & Evenhuis 2014; Van Schrojenstein Lantman-de Valk & Walsh 2008). For example, undetected constipation may cause severe problems such as ileus (Van Schrojenstein Lantman-de Valk & Walsh 2008), and anticonvulsant medication is associated with osteoporosis (Mergler et al. 2009).

Early detection of physical health problems is important in order to improve or maintain health and quality of life (Kerr et al. 2003; Robertson et al. 2014). If health problems remain undiagnosed and untreated, secondary health complications can occur (McCarthy & O’Hara 2011; Cooper et al. 2004; May & Kennedy 2010); therefore, it is important to identify health issues in time. However, little is known about the prevalence of physical health problems in the SPIMD population.

The aim of this systematic review, therefore, is to methodically review cross-sectional studies on the prevalence of various types of physical health problems in adults with SPIMD.

**Methods**

**Information sources**

The Cochrane Library was initially searched in order to confirm that a systematic review did not already exist on physical health issues in adults with SPIMD. Subsequently, a systematic literature search was conducted in the databases of MedLine/PubMed, CINAHL, Embase, PsycINFO and Web of Science. Terms were searched as text words (in title, abstract) and key words that have been indexed by the databases. In addition, the reference lists of the included articles were screened.

**Search strategy**

To ensure capturing all potentially relevant studies, a broad range of search terms was employed. The search terms of profound intellectual and motor disabilities (PIMD) were extended to SPIMD as there is no standardised instrument to assess cognitive functioning in a person who also has severe/profound motor and sensory disabilities (Nakken & Vlaskamp 2007).

Along with searching for studies on individuals with SPIMD, studies regarding individuals with severe or profound intellectual disabilities (SPID) were also examined because most of them have an increased frequency of additional impairments. Furthermore, syndrome-specific terms such as Rett Syndrome were utilised.

To provide a broad overview of all physical health problems, physical health related terms were used in preference to specific health problem terms. An example of the database-specific search for MedLine/PubMed is shown in the Appendix.

**Selection criteria for studies**

Criteria for inclusion in this review included cross-sectional studies, peer-reviewed articles written in
English, published within the last 10 years (between January 2004 and December 2015). Furthermore, participants in the studies were required to be adults with SPID or SPIMD. For a comprehensive overview, studies involving both children and adults and all physical health problems were included. As the focus of the study was on physical health problems, we excluded mental and behavioural disorders such as sleep issues and challenging behaviours. For studies involving adults with a varying degree of ID, a separate analysis of the data on physical health problems for people with SPID was necessary for inclusion. The selection process was performed by the first author. The title and abstract of all of the obtained articles were screened utilising the selection criteria. A second reviewer (A. W.) independently and randomly screened 10% of the titles and abstracts, which yielded an inter-rater agreement of 100%.

Data extraction

Two reviewers (E. A. v. T. and H. A. S.) independently analysed the study characteristics utilising a protocol for data extraction, which was developed specifically for the review and included the following items:

1. Study design
   a. Study design
   b. Population/participants related to the review area
      i. Inclusion/exclusion criteria, setting, country
      ii. Number of participants related to the review area
      iii. Patients characteristics (age, gender)
      iv. Non-response/non-participants
   c. Health problem related to the review area
      i. Definition of health problem
      ii. Measurement of health problem
      iii. Prevalence rates of health problems
   d. Specific issues raised by the study that are relevant to the review area

Discrepancies, for example, in the definition of a health problem or in the total number of participants, were resolved with discussions between the two reviewers.

Assessment of study quality

Because of the absence of standard criteria for the assessment of quality of the cross-sectional studies, an existing assessment tool (Hoy et al. 2012) for determining risk of bias was modified whereby the criteria of the tool and the scores were adapted to the focus of this current review. For external validity (EV), the risk of bias was assessed for the representativeness of the study group with the target group of this review, i.e. people with SPIMD. For internal validity (IV), the method of measurement and definition of the psychical health problem was evaluated. In the event that the physical health problems were not the primary focus of the included study, the quality assessment for IV was limited to the elements of the study that were relevant to the physical health problems related to the review area. The tool contains four items for EV and five items for IV. For the total score, the number of ‘YES’ judgements (i.e. risk of bias) were compiled. A total score of 0 to 1 for EV was considered as a high risk of bias, scores of 2 to 3 as a moderate risk of bias and scores of 4 as a low risk of bias. High risk of bias for internal validity was indicated by total scores of 0 to 1, a moderate risk of bias by scores of 2 to 3 and a low risk of bias by scores of 4 to 5. The two reviewers reached 100% consensus on the total number of quality points for each study.

The protocol for quality assessment included the following items:

External validity

1. Target population representative for the SPIMD group
2. Sampling frame representative for target population
3. Selection of the sample
4. Likelihood of non-response

Internal validity

5. Data collection
6. Definition health problem
7. Measurement health problem
8. Mode of data collection used for all subjects
9. Appropriate numerator(s) and denominator(s)

Data analyses

For this review, the prevalence rate of the physical health problems were classified according to the
categories of the tenth revision of the International Statistical Classification of Diseases (ICD-10).

Prevalence data indicate the number of people with the health problem at a specified time. Therefore, proportion and relative frequency were notated and, if necessary, calculated. A 95% confidence interval (CI) was determined for each health problem using the Confidence Interval Calculator for Proportions (McCallum Layton n.d.). A narrow 95% CI indicates results that are more accurate based on the sample size.

A random effect meta-analysis (Viechtbauer 2010) on the proportions of the individual studies was performed to assess the prevalence of the health problem if three or more studies concerning the same health problem while using the same focus and design were identified. Forest plots were used to visualise meta-analysis results, and the degree of heterogeneity was described by the $I^2$ and $Q$ statistic. The presence of heterogeneity was tested utilising the $Q$ statistic.

**Results**

**Process of study selection**

The database search yielded 9319 results. After eliminating the duplicates, 7034 results remained. A total of 57 records were identified as being potentially relevant for this review.

After a full text review, 16 articles satisfied the eligibility criteria and were subsequently included. In addition, after screening the reference lists of the included articles and using the same selection criteria, another four studies were added. A total of 20 studies met the inclusion criteria. Figure 1 outlines the study selection and lists the explanations for excluding the other studies.

**Description of the studies**

The number of participants ranged from 34 to 562. In seven studies, both adults and children (age 0–82 years) were included (Van der Heide et al. 2009; Petry et al. 2009; Fellinger et al. 2009; Van den Broek et al.)

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**Figure 1** Flowchart of study selection process.

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Eight studies included a study population that was representative for SPIMD (Gittins & Rose 2008; Nagae et al. 2013; Ohwada et al. 2006; Ohwada & Nakayama 2008; Van den Broek et al. 2006; Poppes et al. 2010; Van der Heide et al. 2009; Petry et al. 2009). All of the studies included both male and female. One study analysed data for people with SPID and SPIMD (De Waal et al. 2009). Table 1 contains the characteristics and risk of bias for each study. The studies are listed in order from low to high risk of bias for IV, i.e. the method of measurement and definition of the psychical health problem.

Quality assessment
The quality rating of the studies ranged between moderate and high risk of bias for EV and between low and high risk of bias for IV.

External validity

1 Target population
Twelve studies included a broad range of ID levels in the study population. These studies were assessed as a less accurate representation of the SPIMD group.

2 Sampling frame
The sampling frame, in most of the studies, was a list from only one organisation/institute. In certain studies, the sampling frame consisted of several facilities; however, these studies investigated individuals aged ≥50 (De Winter et al. 2011; Bastiaanse et al. 2012) or did not include people who were living in settings that are more community-based (Poppes et al. 2010) or provided no information in regard to the sampling frame (Hove 2004). None of the sampling frames in the included studies was a genuine or accurate representation of the SPIMD population.

3 Selection sample
In most of the studies, the target population was residing in an institution wherein every person with SPIMD was sampled. There was an elevated risk of bias if not all of those with SPIMD were included (Van den Akker et al. 2006), if participation was open (Lin et al. 2012), if the selection was a component of the research (Hove 2004; Gittins & Rose 2008) or if no information was provided (McGuire et al. 2010; Petry et al. 2009).

4 Likelihood of non-response
In the SPIMD target population, non-response includes non-permission and missing data because of non-cooperation, physical impairments or limited understanding. A high risk was assessed if no information was provided (Poppes et al. 2010; Petry et al. 2009); if participation was voluntary (Lin et al. 2012); if the response rate was <75% and no analysis was performed to compare responders and non-responders (McGuire et al. 2010; Van der Heide et al. 2009; Ohwada et al. 2006; Lohiya et al. 2004; Hove 2004; Ohwada & Nakayama 2008); or if the analysis indicated a significant difference in relevant demographic characteristics between responders and non-responders (Bastiaanse et al. 2012; De Waal et al. 2009). In the remaining 11 studies, a low risk of bias was assessed because the entire sample was included or the response rate was >75%.

Internal validity

5 Data collection method
The methods of data collection in the studies can be divided into clinical examination (n = 9), data from an existing health check-up (n = 4), case file notes (n = 3) and questionnaire by proxy (n = 4). A clinical examination and data from an existing health check-up were considered as a low risk of bias. The remaining two forms of data collection (i.e. case file notes and questionnaire by proxy) were assessed as a high risk of bias.

6 Definition of health problem
Seventeen studies investigated one specific issue. In two cases, no acceptable definition of the health problem was indicated. One study on anaemia employed reference values of the institution instead of the standard value for anaemia proposed by the WHO (Ohwada et al. 2006), and the second study provided no instructions on how to observe pain in people with ID (McGuire et al. 2010). Furthermore, four studies investigated a range of physical health problems wherein no definitions of the specific physical health
Table 1  Characteristics and risk of bias of included studies (n = 20)

<table>
<thead>
<tr>
<th>Author (year of publication)</th>
<th>Number of participants relevant for review (percentage of research population), research population, age (years), gender</th>
<th>Setting + country</th>
<th>Health problem</th>
<th>Methods of diagnosis health problem</th>
<th>Risk of bias: internal validity (score)</th>
<th>Risk of bias: external validity (score)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nagae et al. (2013)</td>
<td>82, SMID, age mean 39.4 (SD 12.6; median 39), men 50%</td>
<td>A residential hospital, Japan</td>
<td>Vitamin K deficiency: based on vitamin K-dependent hepatic markers (indicating bleeding tendency) and vitamin K-dependent bone markers (indicating osteoporosis)</td>
<td>Blood samples for vitamin K status in the liver and bone</td>
<td>Low (5)</td>
<td>Moderate (3)</td>
</tr>
<tr>
<td>Van den Broek et al. (2006)</td>
<td>74, SMID, age mean 33 (SD 12.6; range 4–74), men 58%</td>
<td>A care facility, The Netherlands</td>
<td>Visual functioning: low vision; blind</td>
<td>Visual screening by an orthoptist</td>
<td>Low (5)</td>
<td>Moderate (3)</td>
</tr>
<tr>
<td>Ohwada and Nakayama (2008)</td>
<td>39, SMID, men (n = 21), age mean 38.5 (SD 10.6), women (n = 18), age mean 35.2 (SD 9.9)</td>
<td>A public facility, Japan</td>
<td>Poor nutritional status indicated by serum albumin</td>
<td>Retrospectively analysed the existing health check-up data (blood profile tests) for each resident</td>
<td>Low (5)</td>
<td>Moderate (2)</td>
</tr>
<tr>
<td>Fodstad (2010)</td>
<td>131, SPID (78.9%), study population: 166 mild–profound ID and antipsychotic medication (Axis I diagnoses), age mean 51 (SD 14; range 17–82), Men 54%</td>
<td>A developmental centre, USA</td>
<td>Tardive dyskinesia</td>
<td>Tardive dyskinesia DSM-IV-TR criteria, Dyskinesia Identification System-Condensed User Scale (DISCUS)</td>
<td>Low (5)</td>
<td>Moderate (2)</td>
</tr>
<tr>
<td>Matson (2008)</td>
<td>123, SPID (76.4%), study population: 161 mild–profound ID and long-term psychotropic medication use (Axis I diagnoses), age mean 49.84 (SD 14.31; range 18–90), men 53%</td>
<td>Two developmental centres, USA</td>
<td>Tardive dyskinesia, tardive akathisia</td>
<td>DSM-IV-TR criteria, the outcome of a DISCUS or AIMS administration</td>
<td>Low (5)</td>
<td>Moderate (2)</td>
</tr>
<tr>
<td>Author (year of publication)</td>
<td>Number of participants relevant for review (percentage of research population), research population, age (years), gender</td>
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<td>Methods of diagnosis health problem</td>
<td>Risk of bias: internal validity (score)</td>
<td>Risk of bias: external validity (score)</td>
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<tr>
<td>De Waal et al. (2009)</td>
<td>254, SPID (73.4%), study population: 346 moderate–profound ID, age mean 54.4 (SD 12.2; range 18–82), men 57%, 56, PMD (16%)</td>
<td>A large care provider, The Netherlands</td>
<td>Post-void residual urine volume (PVR)/retention: after voiding, residual volumes above 150 mL</td>
<td>Ultrasound scanning</td>
<td>Low (5)</td>
<td>High (1)</td>
</tr>
<tr>
<td>De Winter et al. (2011)</td>
<td>210, SPID (51%), study population: 470 mild–profound ID, age mean 61.0 (range 50–90), men 27%</td>
<td>Three care providing agencies, The Netherlands</td>
<td>The metabolic syndrome: NCEP-ATP III criteria</td>
<td>Physical examinations and blood samples</td>
<td>Low (4)</td>
<td>Moderate (2)</td>
</tr>
<tr>
<td>Fellinger et al. (2009)</td>
<td>195, SPID (87.1%), study population: 253 moderate–profound ID, age mean 30.7 (SD 8.5; range 3–55), men 62%</td>
<td>An institute for people with ID, Austria</td>
<td>Deaf-blind: hearing impairment and visual impairments</td>
<td>Clinical examination by orthoptists and an audiologist</td>
<td>Low (4)</td>
<td>Moderate (2)</td>
</tr>
<tr>
<td>Ohwada et al. (2006)</td>
<td>39, SMID, men (n = 21), age mean 38.5 (SD 10.6), women (n = 18), age mean 35.2 (SD 9.9)</td>
<td>A public facility, Japan</td>
<td>Anaemia: haemoglobin value in blood. Reference values of the institution. Co-morbid conditions with anaemia</td>
<td>Analysing existing health check-up data (blood profile tests); Review of the medical charts</td>
<td>Low (4)</td>
<td>Moderate (2)</td>
</tr>
<tr>
<td>Bastiaanse et al. (2012)</td>
<td>194, SPID (21.9%), study population: 884 borderline–profound ID, age &gt; 50, men 50.9%</td>
<td>Three care provider services, the Netherlands</td>
<td>Sarcopenia: muscle mass, muscle strength and muscle performance</td>
<td>Calf circumference, grip strength and walking speed</td>
<td>High (1)</td>
<td>Moderate (2)</td>
</tr>
<tr>
<td>Lohiya et al. (2004)</td>
<td>562, SID on whom they could measure bone mineral density (BMD), age mean 45 (range 30–82), men 61%</td>
<td>A long-term care facility for people with severe ID, USA</td>
<td>Low bone mass (measurement BMD)</td>
<td>Measure BMD by peripheral dual-energy X-ray absorptiometry (DXA) on the residents’ middle fingers by Accudexa</td>
<td>Low (4)</td>
<td>High (1)</td>
</tr>
<tr>
<td>Author (year of publication)</td>
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<td>Hsu et al. (2012)</td>
<td>87, SPID (53%), study population: 164 borderline–profound ID, age ≥ 20, mean 33 (SD 9.0), men 61%</td>
<td>A private disability welfare institution, Taiwan</td>
<td>Metabolic syndrome (MS)</td>
<td>Annual health examination chart of 2009</td>
<td>Moderate (3)</td>
<td>Moderate (2)</td>
</tr>
<tr>
<td>Lin et al. (2012)</td>
<td>267, SPID (32.1%), study population: 883 borderline–profound ID who freely participated in the annual health examination, age &gt; 30, mean 61.16 (SD 16.59; range 31–98) men 59%</td>
<td>Health screening by a local government county, Taiwan</td>
<td>Hypertension: elevated blood pressure</td>
<td>Annual health examination chart of 2010</td>
<td>Moderate (3)</td>
<td>High (0)</td>
</tr>
<tr>
<td>Van den Akker et al. (2006)</td>
<td>149, SPID (36.5%), study population: 436 mild–profound ID (for level ID data for 28 persons were missing), age range 0–70+, men 52%</td>
<td>A residential service, The Netherlands</td>
<td>Cardiac diseases</td>
<td>Electronic file with information about cardiac check-up</td>
<td>Moderate (2)</td>
<td>High (1)</td>
</tr>
<tr>
<td>Hove (2004)</td>
<td>?, SID (15.5%), study population: 228 mild–severe ID, age &gt; 18 years, men 51%</td>
<td>Local services from twenty communities, Norway</td>
<td>Underweight BMI &lt; 18.5, Overweight: BMI 25–29.9, Obesity: BMI ≥ 30</td>
<td>Questionnaire sent to health workers</td>
<td>Moderate (2)</td>
<td>High (0)</td>
</tr>
<tr>
<td>McGuire et al. (2010)</td>
<td>34 carers of SPID (21.7%), study population: 157 mild–profound ID, age mean 36.9 (SD 11.7; range 16–70), men 54%</td>
<td>Service users of an organisation, Ireland</td>
<td>Chronic pain: pain experienced most days for a minimum of 6 months</td>
<td>Questionnaires sent to the primary carers</td>
<td>Moderate (2)</td>
<td>High (0)</td>
</tr>
</tbody>
</table>
Table 1. (Continued)

<table>
<thead>
<tr>
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<th>Risk of bias: external validity (score)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poppes et al. (2010)</td>
<td>181, PIMD, age mean 35 (SD 19; range 3–62), men 56%</td>
<td>Seven facilities, The Netherlands</td>
<td>Sensory problems, health problems</td>
<td>Questionnaire completed by the direct support professional</td>
<td>High (1)</td>
<td>Moderate (2)</td>
</tr>
<tr>
<td>Van der Heide et al. (2009)</td>
<td>254, PIMD, age median 49 (range 6–82), men 46%</td>
<td>Eight residential facilities, The Netherlands</td>
<td>Motor disabilities; sensory problems; health problems</td>
<td>Information collected from the medical notes and if necessary additional information from the physician or nurse</td>
<td>High (1)</td>
<td>Moderate (2)</td>
</tr>
<tr>
<td>Gittins &amp; Rose (2008)</td>
<td>61, PMLD, age &gt; 18, mean 37, men ?</td>
<td>A local health district, UK</td>
<td>Visual impairment, hearing impairment, epilepsy, dysphagia, respiratory problems</td>
<td>Information from case files notes</td>
<td>High (1)</td>
<td>Moderate (2)</td>
</tr>
<tr>
<td>Petry et al. (2009)</td>
<td>49, PIMD, age mean 23.7 (SD 12.2; range 5–57), men 53%</td>
<td>A day centre and a residential care facility, The Netherlands and Belgium</td>
<td>Motor limitations, sensory limitations, medical condition, feeding problems</td>
<td>A questionnaire on characteristics of person with PMD completed by ‘indirect support staff’ (e.g. behavioural scientist, therapist)</td>
<td>High (1)</td>
<td>High (1)</td>
</tr>
</tbody>
</table>
problems were signified (Poppes et al. 2010; Petry et al. 2009; Van der Heide et al. 2009; Gittins & Rose 2008).

7 Measurement of health problem
No information regarding the reliability and validity of the measurement of the health problems that are specific for the target population of SPIMD was considered as a high risk of bias. This was the case in most of the studies (n = 13). Only objective measurements such as blood samples, ultrasound scanning of the bladder or clear criteria assessed by specialists were assessed as low risk of bias (n = 7).

8 Mode of data collection
In studies that investigated a range of physical health problems, there was no information on whether the same method was employed when collecting information on the subjects concerning specific physical health problems (Poppes et al. 2010; Petry et al. 2009; Van der Heide et al. 2009; Gittins & Rose 2008). Furthermore, in four studies, information on the mode of data collection was not evidenced (Hove 2004; Van den Akker et al. 2006; Lin et al. 2012; Hsu et al. 2012). In the remaining studies, the same mode of data collection or standardised methods of data collection were utilised.

9 Numerator(s) and denominator(s)
In all of the studies, appropriate numbers and prevalence percentages were provided.

Physical health problems
Table 2 lists, per ICD-10 chapter, the prevalence rate of the physical health problems ascertained in the studies. The results are listed according to whether health problems are addressed in at least three studies, two studies or one study. CIs and risk of bias for IV and EV are provided for each health problem.

Health problems in three or more studies
A random effect meta-analysis was performed for epilepsy, pulmonary/respiratory problems, hearing problems, dysphagia, reflux disease and visual problems. All of the studies included people with SPIMD. Three studies included both adults and children (Poppes et al. 2010; Petry et al. 2009; Van der Heide et al. 2009).

Epilepsy, pulmonary/respiratory problems, hearing problems and dysphagia. The four studies included in the meta-analysis investigated a range of health problems (IV high, EV moderate to high; Poppes et al. 2010, Petry et al. 2009, Van der Heide et al. 2009, Gittins and Rose, 2008).

For epilepsy, the prevalence rate ranged from 64% to 80%. The results of the meta-analysis indicated a prevalence rate of 70% (CI 65–75%) with homogeneity among the observed prevalence across studies (F = 27%; Q = 4.94, df = 3, P = 0.18; Fig. 2).

The prevalence of pulmonary/respiratory problems ranged from 8% to 27%. The meta-analysis indicated a prevalence rate of 21% (CI 12–30%) with heterogeneity among the observed prevalence across studies (F = 84%; Q = 17.90, df = 3, P = 0; Fig. 3).

The prevalence rate of hearing problems varied between 8% and 32.9%. The meta-analysis indicated a prevalence rate of 21% (CI 6–36%) with heterogeneity among the observed prevalence across studies (F = 95%; Q = 56.08, df = 3, P < 0.0001; Fig. 4).

Three studies investigated dysphagia, and the prevalence rates vary from 15% to 50%. The meta-analysis indicated a prevalence rate of 30% (CI 11–50%) with heterogeneity among the observed prevalence across studies (F = 92%; Q = 24.87, df = 2, P < 0.0001; Fig. 5).

Reflux disease. Reflux disease was investigated in three studies. One study included adults (Ohwada et al. 2006), and two studies included both adults and children (Petry et al. 2009; Van der Heide et al. 2009). Prevalence rates ranged between 2.6% and 24%. The meta-analysis indicated a prevalence rate of 16% (CI 2–29%), with heterogeneity among the observed prevalence across studies (F = 93%; Q = 36.49, df = 2, P < 0.0001; Fig. 6).

Visual problems. Prevalence rates of visual problems ranged from 32.7% to 92% in five studies. Four studies used comparable designs and based their findings on a questionnaire by proxy or medical
<table>
<thead>
<tr>
<th>ICD-10 chapter</th>
<th>Prevalence rate (frequency/total) and physical health problem</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood and blood-forming organs and the immune</td>
<td>41% (16/39) SMID and <strong>anaemia</strong></td>
<td>Ohwada et al. 2006</td>
</tr>
<tr>
<td>mechanism (D50-D89)</td>
<td>52.4% (43/82) SMID and high <strong>vit. K-dependent hepatic marker</strong></td>
<td>Nagae et al. 2013</td>
</tr>
<tr>
<td>Endocrine, nutritional and metabolic (E00-E90)</td>
<td>30.5% (25/82) SMID and high <strong>vit. K-dependent bone markers</strong></td>
<td>De Winter et al. 2011</td>
</tr>
<tr>
<td></td>
<td>22.9% (48/210) <strong>SPID and metabolic syndrome</strong></td>
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<td></td>
<td>51.9% (109/210) <strong>SPID and abdominal obesity</strong></td>
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<td></td>
<td>23.3% (49/210) <strong>SPID and low HDL cholesterol</strong></td>
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<td></td>
<td>24.8% (52/210) <strong>SPID and hypertriglyceridemia</strong></td>
<td></td>
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<td></td>
<td>12.4% (26/210) <strong>SPID and insulin resistance</strong></td>
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<tr>
<td></td>
<td>8% (7/87) <strong>SPID and metabolic syndrome</strong></td>
<td>Hsu et al. 2012</td>
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<tr>
<td></td>
<td>25.6% (10/39) <strong>SMID and thyroid dysfunction</strong></td>
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<td></td>
<td>0% (0/39) <strong>SMID and parathyroid dysfunction</strong></td>
<td></td>
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<tr>
<td></td>
<td>5% (2/39) <strong>SMID and low serum albumin level</strong></td>
<td>Ohwada and Nakayama, 2008</td>
</tr>
<tr>
<td>Nervous system (G00-G99)</td>
<td>63% (161/254) <strong>PIMD and spasticity</strong></td>
<td>Van der Heide et al. 2009</td>
</tr>
<tr>
<td></td>
<td>75% (37/49) <strong>PMD and spasticity</strong></td>
<td>Petry et al. 2009</td>
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<tr>
<td></td>
<td>45% (22/49) <strong>PMD and limitations in movement of upper limbs</strong></td>
<td>Petry et al. 2009</td>
</tr>
<tr>
<td></td>
<td>59% (29/49) <strong>PMD and limitations in movement of lower limbs</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>45% (59/131) <strong>SPID and tardive dyskinesia</strong></td>
<td>Fodstad, 2010</td>
</tr>
<tr>
<td></td>
<td>30.1% (37/123) <strong>SPID and tardive dyskinesia</strong></td>
<td>Matson, 2008</td>
</tr>
<tr>
<td></td>
<td>17.9% (22/123) <strong>SPID and tardive dyskinesia and akathisia</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>63.9% (39/61) <strong>PMLD and epilepsy</strong></td>
<td>Gittins &amp; Rose 2008</td>
</tr>
<tr>
<td></td>
<td>71% (180/254) <strong>PIMD and epilepsy</strong></td>
<td>Van der Heide et al. 2009</td>
</tr>
<tr>
<td></td>
<td>79% (39/49) <strong>PMD and epilepsy</strong></td>
<td>Petry et al. 2009</td>
</tr>
<tr>
<td></td>
<td>66.3% (120/181) <strong>PIMD and epilepsy</strong></td>
<td>Poppes et al. 2010</td>
</tr>
<tr>
<td>Eye and adnexa (H00-H59)</td>
<td>62% (158/254) <strong>PIMD and visual problems</strong></td>
<td>Van der Heide et al. 2009</td>
</tr>
<tr>
<td></td>
<td>32.7% (20/61) <strong>PMLD and visual impairment</strong></td>
<td>Gittins &amp; Rose 2008</td>
</tr>
<tr>
<td></td>
<td>92% (68/74) <strong>SPMD and visual impairment</strong></td>
<td>Van den Akker et al. 2006</td>
</tr>
<tr>
<td></td>
<td>54% (26/49) <strong>PMD and visual impairments</strong></td>
<td>Petry et al. 2009</td>
</tr>
<tr>
<td></td>
<td>72.9% (132/181) <strong>PIMD and visual problems:</strong></td>
<td>Poppes et al. 2010</td>
</tr>
<tr>
<td></td>
<td>10% (18/181) <strong>PIMD and blind</strong></td>
<td></td>
</tr>
<tr>
<td>Ear and mastoid process (H60-H95)</td>
<td>65% (114/181) <strong>PIMD and weak-sighted</strong></td>
<td>Van der Heide et al. 2009</td>
</tr>
<tr>
<td></td>
<td>29% (73/254) <strong>PIMD and auditory problems</strong></td>
<td>Gittins &amp; Rose 2008</td>
</tr>
<tr>
<td></td>
<td>8.1% (5/61) <strong>PMLD and hearing impairment</strong></td>
<td>Petry et al. 2009</td>
</tr>
<tr>
<td></td>
<td>8% (4/49) <strong>PMD and auditoitum impairments</strong></td>
<td>Poppes et al. 2010</td>
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<tr>
<td></td>
<td>39.2% (71/181) <strong>PIMD and auditory problems</strong></td>
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<tr>
<td></td>
<td>5% (9/181) <strong>PIMD and deaf</strong></td>
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<tr>
<td></td>
<td>22.7% (41/181) <strong>PIMD and hard of hearing</strong></td>
<td></td>
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<tr>
<td></td>
<td>11.6% (21/181) <strong>PIMD and hypersensitive</strong></td>
<td></td>
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<tr>
<td></td>
<td>2.6% (5/195) <strong>SPID and deaf-blind</strong></td>
<td>Fellinger et al. 2009</td>
</tr>
<tr>
<td></td>
<td>2.6% (5/195) <strong>PMD and severe visual impairment</strong></td>
<td></td>
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<tr>
<td></td>
<td>8.2% (16/195) moderate hearing and profound/severe visual impairment</td>
<td></td>
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<tr>
<td></td>
<td>5.1% (10/195) profound/severe hearing and moderate visual impairment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8.7% (17/195) moderate hearing and visual impairment</td>
<td></td>
</tr>
<tr>
<td>Circulatory system (I00-I99)</td>
<td>60% (126/210) <strong>SPID and hypertension</strong></td>
<td>De Winter et al. 2011</td>
</tr>
<tr>
<td></td>
<td>20.2% (54/267) <strong>SPID and hypertension</strong></td>
<td>Lin et al. 2012</td>
</tr>
<tr>
<td></td>
<td>9.4% (14/149) <strong>SPID had cardiac diseases</strong></td>
<td>Van den Akker et al. 2006</td>
</tr>
<tr>
<td></td>
<td>15% (39/254) <strong>PIMD and cardiovascular problems</strong></td>
<td>Van der Heide et al. 2009</td>
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<tr>
<td></td>
<td>6% (16/254) <strong>PIMD and congenital heart disease</strong></td>
<td></td>
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<tr>
<td></td>
<td>9% (24/254) <strong>PIMD and other cardiovascular problems</strong></td>
<td></td>
</tr>
<tr>
<td>Respiratory system (J00-J99)</td>
<td>2.6% (1/39) <strong>SMID and tonsillitis</strong></td>
<td>Ohwada et al. 2006</td>
</tr>
<tr>
<td></td>
<td>0% (0/39) <strong>SMID and sinusitis</strong></td>
<td>Gittins &amp; Rose 2008</td>
</tr>
<tr>
<td></td>
<td>8.1% (5/61) <strong>PMLD and respiratory problems</strong></td>
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</tbody>
</table>

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Table 2. (Continued)

<table>
<thead>
<tr>
<th>ICD-10 chapter</th>
<th>Prevalence rate (frequency/total) and physical health problem</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digestive system (K00-K93)</td>
<td>26% (13/49) PMD and problems with the bronchial tubes</td>
<td>Petry et al. 2009*</td>
</tr>
<tr>
<td></td>
<td>27.1% (49/181) PMD and pulmonary/respiratory problems</td>
<td>Poppes et al. 2010*</td>
</tr>
<tr>
<td></td>
<td>23% (58/254) PMD and pulmonary problems</td>
<td>Van der Heide et al. 2009*</td>
</tr>
<tr>
<td></td>
<td>5.1% (2/39) SMID and liver disease</td>
<td>Ohwada et al. 2006</td>
</tr>
<tr>
<td></td>
<td>26% (47/181) PIMD and dental problems</td>
<td>Poppes et al. 2010*</td>
</tr>
<tr>
<td></td>
<td>44% (21 of 22/49) PMD and constipation</td>
<td>Petry et al. 2009*</td>
</tr>
<tr>
<td></td>
<td>75.7% (137/181) PIMD and bowel and abdominal problems</td>
<td>Ohwada et al. 2006</td>
</tr>
<tr>
<td></td>
<td>72% (183/254) PIMD and gastrointestinal problems</td>
<td>Van der Heide et al. 2009*</td>
</tr>
<tr>
<td></td>
<td>2.6% (1/39) SMID and gastroesophageal reflux disease</td>
<td>Ohwada et al. 2006</td>
</tr>
<tr>
<td></td>
<td>5.1% (2/39) SMID and gastrointestinal disease</td>
<td>Van der Heide et al. 2009*</td>
</tr>
<tr>
<td></td>
<td>60% (152/254) PIMD and constipation</td>
<td>Van der Heide et al. 2009*</td>
</tr>
<tr>
<td></td>
<td>5% (137/181) PMD and feeding problems</td>
<td>Ohwada et al. 2006</td>
</tr>
<tr>
<td>Musculoskeletal system and connective tissue (M00-M99)</td>
<td>69% (34/49) PMD and deformities</td>
<td>Petry et al. 2009*</td>
</tr>
<tr>
<td></td>
<td>20% (52/254) PMD and deformities/contractures</td>
<td>Van der Heide et al. 2009*</td>
</tr>
<tr>
<td></td>
<td>30% (77/254) PMD and scolioses</td>
<td>Van der Heide et al. 2009*</td>
</tr>
<tr>
<td></td>
<td>19% (47/254) PMD and hip problems</td>
<td>Van der Heide et al. 2009*</td>
</tr>
<tr>
<td></td>
<td>45.2% (254/562) SPID and low bone mineral density (BMD)</td>
<td>Lohiya et al. 2004</td>
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<tr>
<td></td>
<td>17.4% (98/562) SPID and osteoporotic</td>
<td>Bastiianse et al. 2012</td>
</tr>
<tr>
<td></td>
<td>27.8% (156/562) SPID and osteopenic</td>
<td>Ohwada et al. 2006</td>
</tr>
<tr>
<td></td>
<td>24.2% (47/194) SPID and sarcopenia</td>
<td>Van der Heide et al. 2009*</td>
</tr>
<tr>
<td>Genitourinary system (N00-N99)</td>
<td>0% (0/39) SMID and renal disease</td>
<td>De Waal et al. 2009</td>
</tr>
<tr>
<td></td>
<td>10% (5/49) PMD and problems with the urinary tract system</td>
<td>Van der Heide et al. 2009*</td>
</tr>
<tr>
<td></td>
<td>17% (43/254) PMD and urinary tract problems</td>
<td>Van der Heide et al. 2009*</td>
</tr>
<tr>
<td></td>
<td>9.4% (24/254) SPID and post-void residual urine</td>
<td>Van der Heide et al. 2009*</td>
</tr>
<tr>
<td></td>
<td>14% (8/56) PMD and post-void residual urine</td>
<td>Van der Heide et al. 2009*</td>
</tr>
<tr>
<td>Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (R00-R99)</td>
<td>33.7% (61/181) PMD and tactile problems</td>
<td>Poppes et al. 2010*</td>
</tr>
<tr>
<td></td>
<td>23.2% (42/181) PMD and hypersensitive</td>
<td>Van der Heide et al. 2009*</td>
</tr>
<tr>
<td></td>
<td>10% (18/181) PMD and undersensitive</td>
<td>Van der Heide et al. 2009*</td>
</tr>
<tr>
<td></td>
<td>14.9% SID and underweight</td>
<td>Hove, 2004</td>
</tr>
<tr>
<td></td>
<td>21.3% SID and overweight</td>
<td>Hove, 2004</td>
</tr>
<tr>
<td></td>
<td>10.6% SID and obesity</td>
<td>Hove, 2004</td>
</tr>
<tr>
<td></td>
<td>12.1% (4/33) SPID and mild level of pain</td>
<td>McGuire et al. 2010*</td>
</tr>
<tr>
<td></td>
<td>26% (47/181) PMD and pain</td>
<td>Poppes et al. 2010*</td>
</tr>
<tr>
<td></td>
<td>17% (44/254) PMD and skin problems</td>
<td>Van der Heide et al. 2009*</td>
</tr>
</tbody>
</table>

*Studies included adults and children
**Population with ID, diagnosed with an Axis I disorder and use of atypical antipsychotic medication
SMID, severe motor and intellectual disabilities; SPMD, severe and profound intellectual and motor disabilities; SPID, severe or profound intellectual disability; PMD, profound multiple disabilities; SID, severe intellectual disability; PIMD, profound intellectual disability and a profound or severe motor disability; PIMD, profound intellectual and multiple disabilities; PMLD, profound and multiple learning disabilities; PSMI, persons with severe motor and intellectual disabilities.

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Figure 2  Forest plot: epilepsy, $N=545$.

Figure 3  Forest plot: pulmonary/respiratory problems, $N=545$.

Figure 4  Forest plot: hearing problems, $N=545$.

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records. One study included adults (Gittins & Rose 2008), and three studies included both adults and children (Petry et al. 2009; Van der Heide et al. 2009; Poppes et al. 2010). The meta-analysis indicated a prevalence rate of 56% (CI 39–73%) with heterogeneity among the observed prevalence across studies ($I^2 = 93\%$; $Q = 36.14, df = 3, P < 0.0001$; Fig. 7).

The fifth study employed a different focus and design and, therefore, was not included in the meta-analysis. Van den Broek et al. (2006) ascertained a prevalence rate of 92% (CI 85.8–98.2%; IV low, EV moderate) based on visual screening by an orthoptist.

**Health problems identified in two studies**

Thirteen health problems were identified in two studies. The prevalence (CI, IV and EV) are described per health problem/per study and listed according to risk of bias for IV.

**Tardive dyskinesia.** A prevalence rates of 30.1% (CI 22–38.2%; IV low, EV moderate; Matson et al. 2008) and 45% (CI 36.5–53.5%; IV low, EV moderate; Fodstad et al. 2010) were reported for tardive dyskinesia in individuals with SPID who used antipsychotic medication.

**Metabolic syndrome.** Prevalence rates determined for metabolic syndrome were 8% (CI 2.3–13.7%; IV moderate, EV moderate; Hsu et al. 2012) and 22.9% (CI 17.2–28.6%; IV low, EV moderate; De Winter et al. 2011).

**Hypertension.** The prevalence rates of hypertension were 20.2% (CI 15.4–25%; IV moderate, EV high;
Lin et al. 2012) and 60% (CI 53.4–66.6%; IV low, EV moderate; De Wintert et al. 2011).

**Cardiovascular problems.** A prevalence of 9.4% was found in adults and children with SPID (CI 4.7–14.1%; IV moderate, EV high; Van den Akker et al. 2006) and 15% with cardiovascular problems in adults and children with SPIMD (CI 11–19.8%; IV high, EV moderate; Van der Heide et al. 2009).

**Pain.** The prevalence rates were 12.1% mild pain in adults and children with SPID (CI 1–23.2%; IV moderate, EV high; McGuire et al. 2010) and 26% pain in adults and children with SPIMD (CI 19.6–32.4%; IV high, EV moderate; Poppes et al. 2010).

**Spasticity, constipation, feeding/drinking problems, feeding tube, deformities and urinary tract problems.** Two studies investigated spasticity, constipation, feeding/drinking problems, feeding tube, deformities and urinary tract problems in adults and children (IV high EV moderate; Van der Heide et al. 2009, IV high, EV high; Petry et al. 2009).

Prevalence rates were spasticity 63% (CI 57.1–68.9%; Van der Heide et al. 2009) and 75% (CI 62.9–87.1%; Petry et al. 2009); constipation 44% (CI 30.1–57.9%; Petry et al. 2009) and 60% (CI 54–66%; Van der Heide et al. 2009); feeding/drinking problems 34% (CI 28.2–39.8%; Van der Heide et al. 2009) and 76% (CI 64–88%; Petry et al. 2009); deformities (including scoliosis and hip problems) 69% (CI 63.3–74.7%; Van der Heide et al. 2009) and 69% (CI 56.1–82%; Petry et al. 2009); urinary tract problems 10% (CI 1.6–18.4%; Petry et al. 2009) and 17% (CI 12.4–21.6%; Van der Heide et al. 2009); feeding tube 13% (CI 8.9–17.1%; Van der Heide et al. 2009) and 29% (CI 16.3–41.7%; Petry et al. 2009). There was no information regarding the type of feeding tube.

**Dental problems.** Prevalence rates for dental problems in adults and children varied from 5% (CI 2.3–7.7%; IV high, EV moderate; Van der Heide et al. 2009) to 26% (CI 19.6–32.4%; IV high, EV moderate; Poppes et al. 2010).

**Gastrointestinal problems.** Prevalence rates of gastrointestinal problems were 5.1% (CI 1.8–12%; IV high, EV moderate; Ohwada et al. 2006) and 72% in adults and children (CI 66.5–77.5%; IV high, EV moderate; Van der Heide et al. 2009).

**Health problems identified in one study**

Sixteen health problems were identified in a single study. The prevalence of the health problems (CI, IV and EV) are described per study and listed according to risk of bias for IV.

**Vitamin K deficiency.** The vitamin K-dependent liver marker exceeded the upper normal range in 52% (CI 41.6–63.2%), and the vitamin K-dependent bone marker was above the upper reference in 30% (CI 20.5–40.5%; IV low, EV moderate; Nage et al. 2013).
Low serum albumin. One study reported a prevalence rate of 5% of low serum albumin level (CI 1.8–11.8%; IV low, EV moderate; Ohwada & Nakayama 2008).

Post-void residual urine. The prevalence rates of post-void residual urine were 9.4% in people with SPID (CI 5.8–13%; IV low, EV high) and 14% for those with SPIMD (CI 4.9–23.1%; IV low, EV moderate; De Waal et al. 2009).

Deaf-blind. A prevalence rate of 24.6% of deaf/blindness in people was reported in adults and children (CI 18.6–30.6%; IV low, EV moderate; Fellinger et al. 2009).

Anaemia, thyroid dysfunction, tonsillitis and liver disease. A prevalence rate of 41% was found for anaemia (CI 25.6–56.4%, IV low, EV moderate).

Furthermore, Ohwada et al. (2006) reported thyroid dysfunction 25.6% (CI 11.9–39.3%), tonsillitis 2.6% (CI 2.4–7.4%) and liver disease 5.1% (CI 1.8–11.8%) (IV high, EV moderate).

Sarcopenia. A prevalence of 24.2% of sarcopenia was reported (CI 18.2–30.2%; IV low, EV high; Bastiaanse et al. 2012).

Osteoporosis. A prevalence of 45.2% of low bone mineral density was found (CI 41.1–49.3%; IV low, EV high; Lohiya et al. 2004).

Underweight, overweight and obesity. The prevalence rates on weight were 14.9% underweight, 21.3% overweight and 10.6% obesity (IV moderate, EV high; Hove 2004). The number of persons with severe ID was unclear; therefore, no confidence interval could be calculated.

Bowel/abdominal problems and tactile problems. For bowel and abdominal problems, a prevalence rate was determined of 75.7% (CI 69.5–82%), and for tactile problems, 33.7% (CI 26.8–40.6%) was reported in adults and children (IV high, EV moderate; Poppes et al, 2010).

Hiatus hernia and skin problems. A prevalence rate of 15% hiatus hernia (CI 10.3–18.9%) and 17% for skin problems (CI 12.4–21.6%) was reported in adults and children (IV high, EV moderate; Van der Heide et al. 2009).

Chewing difficulties. A prevalence rate of 61% chewing difficulties was reported in adults and children (CI 47.3–74.7%; IV high, EV high; Petry et al. 2009).

Discussion

The aim of this study was to systematically review cross-sectional studies on the prevalence of various types of physical health problems in adults with SPIMD. Our systematic review identified 35 physical health problems in 20 different studies.

For six health problems, a meta-analysis was conducted. A homogeneous prevalence rate was ascertained for epilepsy 70% (CI 65–75%). For the remaining five health problems, heterogeneous results were found, with a significant degree of inconsistency between the results of the studies which were based on case file notes or questionnaire by proxy and, therefore, these prevalence estimates are likely to be an underestimation of the true prevalence (Haveman 2004).

The results of the meta-analysis of visual problems indicated a prevalence rate of 36% (CI 39–73%). However, Van den Broek et al. (2006) determined a prevalence rate of 92% (CI 85.8–98.2%) in people with SPIMD based on visual screening by an orthoptist, which confirms that problems with sensory functions are easily overlooked, and health screenings can identify previously unrecognised health problems (Felce et al. 2009; Felce et al. 2008; Robertson et al. 2014; Kerr et al. 2003). For the health problems identified in two studies or in a single study, the degree of evidence is minimal. There were three important variabilities between the studies: (1) diversity in the definition of a health problem, for example, metabolic syndrome (De Winter et al. 2011; Hsu et al. 2012), hypertension (De Winter et al. 2011; Lin et al. 2012) and feeding problems (Petry et al. 2009; Van der Heide et al. 2009); (2) lack of definition of a health problem, for example, feeding/drinking problems and urinary tract problems (Petry et al. 2009; Van der Heide et al. 2009); (3) differences in the study population, e.g. differences in mean age (De Winter et al. 2011; Hsu et al. 2012) and differences in sample selection (De Winter et al. 2011; Lin et al. 2012).
As expected, higher prevalence rates were found in our review compared with people with ID for a cluster of health problems that are associated with brain damage/dysfunction. Reported prevalence rates in individuals with ID were visual problems 19.2% (Van Splunder et al. 2006) against 56% and 92% in the present review; epilepsy 22.2% (Robertson et al. 2015) against 70% in the present review; and spasticity 14.6% (Maaskant et al. 1994) against 63% and 75% in the present review. Unexpected lower prevalence rates were compared with people with ID ascertained for constipation 70% (Böhmer et al. 2001) against 44% and 60% in the present review; dysphagia 33% (Rogers et al. 1994) against 30% in the present review; reflux disease 48% (Böhmer et al. 1999) against 16% in the present review; and hearing problems 30% (Meuwese-Jongejeugd et al. 2006) against 21% in the present review. This is of concern because undiagnosed and untreated dysphagia and reflux disease can lead to recurrent respiratory tract infections, which is a possible leading cause of death for people with ID (Emerson & Baines 2010).

This systematic review is restricted to recent publications because increase in the quality of support combined with advances in medical care may possibly influence the detection rate of physical health problems. As a consequence, relevant studies published prior to 2004 were probably missed. A strength of this study is the thorough search strategy in six databases with the utilisation of a broad range of search terms. For a comprehensive overview, studies were included in which the physical health problems were not the primary focus but were collected as characteristics of individuals with SPIMD. Furthermore, studies regarding both children and adults were included. This may affect the type and prevalence of the reported health problems. For example, long-term use of medication may lead to different physical health problems during adulthood. In addition, studies that focused on people with SPIMD used slightly different terms to describe the target population. However, as the alternative was a less complete overview of the available literature, we considered this the most appropriate inclusion method. Another strength of this study is the detailed critical appraisal of the studies assessing a risk of bias for IV and EV. At the time that this systematic review was conducted, there was no standard method for critical appraisal of studies of prevalence data; therefore, an existing risk of bias checklist was modified. Recently, a new tool was developed specifically for studies reporting prevalence data (Munn et al. 2014).

It is believed that the current review is the first that provides an overview of the current state of the art research on the prevalence of health problems in adults with SPIMD. Only eight studies included a study population representative for SPIMD, and not all of the studies focused primarily on physical health issues. The included studies were diverse, and most studies focused on a single or a minimal number of somatic problems rather than on the entire range that were experienced. There is a strong need for comprehensive epidemiological data in order to determine clusters of health problems that are specific for people with SPIMD. This would provide insight into the excess morbidity associated with SPIMD.

References


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**Appendix I: Search string Database MedLine/PubMed**


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