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Review
Prevalence of erectile dysfunction: a systematic review of population-based studies

J Prins[1,2], MH Blanker[1]*, AM Bohnen[1], S Thomas[1] and JLHR Bosch[2]

[1]*Department of General Practice, Erasmus University Rotterdam, The Netherlands; and* [2]*Department of Urology, University Hospital Rotterdam, The Netherlands*

A systematic review was conducted on the prevalence of erectile dysfunction (ED) in the general population. Studies were retrieved which reported prevalence rates of ED in the general population. Using a specially developed criteria list, the methodological quality of these studies was assessed and data on prevalence rates were extracted. We identified 23 studies from Europe (15), USA (5), Asia (2) and Australia (1). On our 12-item criteria list, the methodological quality ranged from 5 to 12. The prevalence of ED ranged from 2% in men younger than 40 y to 86% in men 80 y and older. Comparison between prevalence data is hampered by major methodological differences between studies, particularly in the use of various questionnaires and different definitions of ED. We stress the importance of providing all necessary information when reporting on the prevalence of ED. Moreover, international studies should be conducted to establish the true prevalence of ED across countries.
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Introduction

Epidemiological research on erectile dysfunction (ED) is rapidly growing and studies on the prevalence of ED in the general population have recently been published. Subsequently, several unsystematic reviews have summarised selections from these studies.[1–5] Although most of these reviews conclude that the prevalence of ED differs between studies, the interpretation of these reviews is hampered by several problems. First, the methods used for the selection of articles are not presented in any of the reviews, second, no comment is made on the validity of the separate studies, and third, little attention is given to the definitions of ED used. These shortcomings are consistent with those found in epidemiological reviews in other research yields.[6] To elucidate on the prevalence of ED in the general population, a systematic review study was conducted in which particular attention was paid to the methodological quality and value of the individual studies. For this purpose, a criteria list for the validity assessment of prevalence studies was developed.

*Correspondence: MH Blanker, Department of General Practice, Erasmus University Rotterdam, Room Ff323, PO Box 1738, 3000 DR Rotterdam, The Netherlands.
E-mail: blanker@hag.fgg.eur.nl
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Materials and methods

Search strategy

In December 2001, a search was made from 1966 to December 2001 in the Medline and Psychinfo database using the following keywords: [impotence OR erectile dysfunction OR sexual dysfunction] AND [general population OR community-based OR population-based OR epidemiology]. All items were searched using 'All fields'. Literature search was limited to the English and Dutch languages.

Titles and abstracts of identified published articles were reviewed independently (by JP and MHB) to determine the relevance of the articles. Each citation was classified as 'inclusion', 'unsure' or 'exclusion'. In case of disagreement between the two reviewers, consensus was reached to solve the disagreement. After this, excluded citations were no longer considered. Reference lists of included articles were checked to identify additional studies not found in the Medline nor in the psych-info database.

Selection of studies

Included studies were assessed in detail (by JP and MHB) to make a final selection of studies for the

Table 1 Criteria for the methodological quality assessment of prevalence studies

External validity	
Source population	
(a)	Does the method to select and invite participants result in a study population that covers the complete population or a random sample?
Description of eligibility criteria	
(b)	Is the age range specified?
(c)	Are inclusion and exclusion criteria specified?
Participants and nonresponders	
(d)	Is the response rate $>70\%$, or is the information on nonresponders sufficient to make inference on the representativeness of the study population?
Description of study period	
(e)	Is the study period specified?
Description of study population	
(f)	Are important population characteristics[a] specified?
Internal validity	
Data collection	
(g)	Are the data prospectively collected?
Measurement instrument (questionnaire, interview, additional)	
(h)	Is the measurement instrument validated?
(i)	Is the period covered by the measurement instrument specified?
Definition of diseases[b]	
(j)	Is a definition of the disease stated?
Reported prevalences	
(k)	Are age-specific and gender-specific prevalences reported?
(l)	Are possible correlates of disease[b] reported?
Informativity	
(m)	Is the method of data collection properly described (interview, questionnaire, additional measurement)?
(n)	Are the questions and answer possibilities stated?
(o)	Are the reported prevalence rates reproducible?

[a]Two or more of: (i) age distribution; (ii) relevant comorbidity; (iii) lifestyle factors (eg smoking and alcohol consumption); and (iv) socio-economic data (eg income, educational level, marital status).
[b]Disease equals erectile dysfunction in this review.

review. Eligible were studies with a cross-sectional study design or cohort studies that included men drawn from the general population and reported original data on prevalence rates of erectile dysfunction. Papers consisting of abstracts only were omitted.

Methodological quality assessment

In the judgement of methodological quality two aspects of validity are important: external validity relates to the applicability of study results to other populations, whereas internal validity implies accurate measurement apart from random error. As no criteria list for the quality assessment of prevalence studies was available, a list was designed (see Table 1), which includes six items on internal validity, six items on external validity and three items on informativity. The latter items are not included in the methodological quality assessment but give an indication of the presentation of the reports. All items were scored positive or negative independently (by JP and MHB) and their importance was not weighed. For feasibility reasons, the quality assessment was not performed under masked conditions. In case of disagreement, consensus was reached.

Data extraction

Using standardized forms, two reviewers (JP and MHB) independently extracted information and data from the individual studies. When no or insufficient information was provided in the article, we searched the Medline database for other papers on the same study to obtain additional information, using authors names or specific study groups. For feasibility reasons, no attempts were made to directly contact authors of published papers.

Comparison of studies

The methodology of the individual studies was compared to establish whether comparison of the reported prevalence rates would be appropriate and meaningful.

Results

Selection of studies

The primary search yielded 581 citations, of which 63 were selected for full review, including 11 unsure citations for which no abstract was available. A check of the reference list of these papers yielded 39 additional citations, of which 30 were selected for full review. Thus, 93 citations were reviewed for eligibility. Of these, 47 papers were omitted for the following reasons: lack of original data ($n=25$, of which 13 were review articles), study population not derived from general population ($n=8$), paper consisted of abstract only ($n=2$), paper contained no information on ED ($n=8$), no additional information ($n=1$), not available ($n=3$). Ten papers originated from the Massachusetts Male Ageing Study (MMAS); of these, four papers were used to obtain all necessary information; the other six provided no additional information relevant for this review. One article was found with additional information about the selected studies. Finally, data from 40 papers provided information on 23 studies.[7–46] Only two of these studies were selected by means of checking the reference lists.

Methodological quality assessment

Table 2 shows the results of the quality assessment. On average, 4.5 items (range 1–6) on external validity were scored positive, as were 4.3 (range 2–6) on internal validity. Only two studies scored positive for all of the 12 validity criteria;[40,41,45] however, when considering the single question on ED, both these latter studies scored negatively on two items (*h* and *i*) of internal validity.

Description of selected study populations

A description of the populations included in the selected studies is given in Table 3. In 11 studies, the eligibility criteria were not specified. No information on nonresponders was available in 11 studies, whereas in five studies specific information was obtained from (a sample of) the nonresponders; seven other studies compared participant characteristics to external databases, baseline population register or characteristics of baseline participants. In another study, due to the sampling method (stratified on continence state), the study population could not be generalized to the community from which the participants were selected.[7]

Table 2 Year published and quality assessment of selected studies

Reference number	Year[a]	External validity							Internal validity							Informativity				Disagreement[b]
		a	*b*	*c*	*d*	*e*	*f*	*Sum*	*g*	*h*	*i*	*j*	*k*	*l*	*Sum*	*m*	*n*	*o*	*Sum*	
7	1990	−	+	−	−	−	−	1	+	−	−	+	+	+	4	+	+	−	2	
8, 9	1993	+	+	−	+	+	+	5	+	−	+	+	+	−	4	+	+	+	3	*m*
10–13	1994	+	+	+	+	+	+	6	+	−	+	+	+	+	5	+	+	−	2	*d*, *h*, *i*
14–16	1995	+	+	+	+	+	+	6	+	−	+	+	+	−	4	+	+	− [c]	2	*l*
17, 18	1996	+	+	+	+	+	+	6	+	−	−	+	+	+	4	+	+	+	3	*h*
19, 20	1996	+	+	+	−	+	+	5	+	−	+	+	+	−	4	+	+	+	3	*l*
21	1997	+	+	−	+	+	+	5	+	−	−	−	+	−	2	+	−	+	2	
22	1998	+	+	−	−	+	−	3	+	−	−	+	+	−	3	+	+	−	2	
23, 24	1998	+	+	+	−	−	−	3	+	−	−	+	+	+	4	+	+	+	3	
25	1998	+	+	+	−	+	−	4	+	−	−	+	+	−	3	+	+	+	3	
26, 27	1998	+	+	−	−	+	+	4	+	−	+	+	−	+	4	+	+	+	3	*h*
28	1999	+	+	+	−	+	+	5	+	−	+	+	+	+	5	+	−	+	2	
29, 30	1999	+	+	+	+	+	−	5	+	−	+	+	+	+	5	+	+	+	3	*o*
16, 31, 32	1999	+	+	+	−	−	−	3	+	−	+	+	+	−	4	+	+	+	3	
33, 34	1999	+	+	−	−	+	+	4	+	+	+	+	+	+	6	+	+	+	3	
35	2000	+	+	−	+	+	+	5	+	−	−	+	+	+	4	+	−	−	1	*o*
36, 37	2000	+	+	−	−	+	+	4	+	−	+	+	+	+	5	+	−	+	2	
38	2000	+	+	−	−	−	+	3	+	−	+	+	+	+	5	+	−	+	2	*m*
39	2000	+	+	−	+	−	+	4	+	+	−	+	+	+	5	+	+	−	2	
40, 41	2001	+	+	+	+	+	+	6	+	+	+	+	+	+	6[d]	+	+	+	3	
42–44	2001	+	+	+	+	+	+	6	+	−	−	+	+	+	4	+	+	+	3	
45	2001	+	+	+	+	+	+	6	+	+	+	+	+	+	6[e]	+	+	+	3	
46	2001	+	+	−	+	−	+	4	+	−	−	+	+	+	4	+	+	−	2	*m*

Items *a*–*o* refer to Table 1.
[a]Year published. [b]Items on which the two reviewers disagreed; consensus reported.
[c]Information not reproducible from original reports, data extracted from reference 31.
[d]Score on sexual function inventory (SFI), single question not validated and no period covered by questionnaire specified (ie negative score on item *h* and *i*; sum score 4); [e]score on international index for erectile function (IIEF), single question not validated and no period covered by questionnaire specified (ie negative score on item *h* and *i*; sum score 4).

Table 3 Description of the populations in the selected studies

Reference number	*Design*[a]	*Source population and selection of participants*	*Eligibility criteria*		*Participants and nonresponders*	
			Age (y)	*Other*	n *(%)*[b]	*Representativeness*
7	CS	Washetenaw County, MI, USA Probability population sample; stratified (age, continence, gender) sample of participants	60+	NS	283 (29)	Comparison with non-responders Second phase: participants poorer health, older, more often incontinent
8, 9	CS	Copenhagen, Denmark All men in selected communes	51	NS	439 (81)	Comparison with other Danish samples: different employment status; cohabitation, social groups similar
10–13	CS	Boston, MA, USA Random population sample	40–70	Men with sexual partner	1290 (40)	Interview 206 non-responders (54%): participants more heart disease and cancer; diabetes, hypertension, arthritis or restricted activity attributed to health similar
14–16	Survey	Olmsted County, MN, USA Random population sample	40–79	No prostate/bladder cancer/surgery, low back surgery, CVA, neurogenic bladder, antiandrogen use	2115 (55)	Questionnaire 637 'partial participants' (36%) and medical record information: participants more urological diseases; chronic diseases similar
17, 18	Survey	Stockholm area, Sweden Stratified (age) random population sample	50–80	Born in Sweden, no prostate cancer[c]	315 (72)	Comparison with Swedish statistics: participants more hypertension; prostate cancer, diabetes mellitus and myocardial infarction similar
19, 20	Survey	France Stratified (region) random population sample	50–80	No previous urethral bladder disease, radiotherapy to prostate/pelvic area or prostate cancer	1734 (53)	NS
21	Survey	Göteborg, Sweden Stratified (birth cohort) random population sample	45+	NS 5 y steps	7763 (74)	Comparison with population register all 2695 nonresponders: social factors similar
22	Survey	Denmark Stratified (birth cohort) random population sample	18–88 5 y steps	NS	626 (51)	NS
23, 24	CS	Leicestershire, UK All men registered at general practice	40+	Ambulant, no prostate cancer or surgery, urinary problems caused by surgical treatment or neuro-logical damage	423 (65)	NS
25	Survey	Tampere, Finland Stratified (birth cohort) random population sample	50, 60, 70	Non-institutionalized	1983 (63)	NS
26, 27	Survey	UK Stratified (age, gender) random sample from general practice registers	18–75	NS	1768 (39)	NS

Table 3 cont.

Table 3 Continued

Reference number	*Design*[a]	*Source population and selection of participants*	*Eligibility criteria*		*Participants and nonresponders*	
			Age (y)	*Other*	n *(%)*[b]	*Representativeness*
28	Survey	USA Random population sample	18–59	Not from barracks, college dormitories or prisons. English-speaking, at least one sexual partner in prior year	1244 (70)	NS
29, 30	Survey	Sweden Random population sample	18–74	Domicile in Sweden, adequately mentally and physically able	1288 (52)	Comparison with all nonresponders: 'no sign of distortion of the material'; participants younger, more men
16, 31, 32	CS	Shimamaki-mura, Japan All men	40–79	No prostate/bladder cancer/ surgery, low back surgery, CVA, neurogenic bladder, antiandrogen use	289 (42)	NS
33, 34	Survey	South Australia Probability population sample; all participants second phase	40+	NS	371 (35)	Comparison with all 374 nonresponders second phase: age, marital status, blood pressure (medication), cholesterol and triglyceride levels, or visit to physician for LUTS similar
35	Survey	Italy Random sample from general practice registers	18+	NS	2010 (79)	NS
36, 37	Survey	Thailand Selection NS	40–70	NS	1250 (?)	NS
38	Survey	New York, NY, USA Stratified (age) random population sample	50–76	NS	1438 (28)	Questionnaire 27 non-responders (25%): prevalence of ED similar
39	Survey	Cologne district, Germany Stratified (age, marital status) random population sample	30–80	NS	4489 (56)	Comparison with German socio-economic data: marital status, family income similar
40, 41	Survey	Boxmeer, The Netherlands Stratified (age) random population sample	40–79	Dutch- speaking	1233 (70)	Interview 45 non-responders (8%): participants more symptoms, more often married
42–44	CS	Krimpen aan den IJssel, The Netherlands All men registered in all general practices	50–78	No prostate/bladder cancer, radical prostatectomy, neurogenic bladder disease or negative advice by GP	1605 (47)	Questionnaire 261 nonresponders (55%): participants more LUTS and better health status; chronic diseases, medication use, social and lifestyle factors similar
45	Survey	Spain Stratified (age, community, population density) random population sample	25–70	Non-institutionalized	2476 (75)	NS
46	CS	Gwent, Wales, UK All men registered in 11 general practices	55–70	NS	2027 (50)	Comparison with Gwent Census: participants more often married; racial composition similar

[a] Design: survey (questionnaire only) or CS (cross-sectional study with additional measurements).
[b] Response rate calculated as number of participants available for analyses divided by total of eligible men.
[c] References present different eligibility criteria on same study population. NS not specified; LUTS, lower urinary tract symptoms.

Table 4 Method used to obtain information on erectile dysfunction, definition and prevalence rates

Reference number	*SAQ/interview*[a]	*Definition of erectile dysfunction and severity when applicable*	*Time period*	*Prevalence rates (%)*	
				Age (y)	*Percentage (95% CI)*[b]
7	Interview	'Impotence': difficulty in getting or maintaining an erection	NS	60+	40 (35–46)
8, 9	SAQ	ED: impaired erection making sexual intercourse impossible on more than a few occasions No ED: impaired erection making sexual intercourse impossible only occasionally or never	Year	51	4 (2–6)
10–13	SAQ	Moderate to complete impotence: sometimes able or never able to get and keep an erection good enough for sexual intercourse	6 months	40 45 50 55 60 65 70	23 (?)[c] 27 32 36 40 45 49
14–16	SAQ	ED: ability to have an erection when sexually stimulated none of the time[d] No ED: ability to have an erection when sexually stimulated a little of the time—all of the time	Month	40–49 50–59 60–69 70–79	1 (0–2) 6 (4–8) 22 (18–26) 44 (38–51)
17, 18	SAQ	'Psychological impotence': erectile stiffness seldom, hardly ever or never sufficient for intercourse or not relevant (no penis stiffness) No impotence: approximately as in youth-sufficient for intercourse most of the time or always	Few months	50–59 60–69 70–80	3 (0–11) 24 (17–33) 49 (41–58)
19, 20	SAQ	'Erection difficulty': difficulty in having an erection each time or some time[d] No erection difficulty: rarely or never difficulty in having an erection	Month	50–59 60–69 70–79	20 (17–23) 33 (29–37) 38 (33–44)
21	SAQ	NS	NS	50[e] 60 70 80 90+	2 (1–4) 8 (7–11) 10 (8–13) 18 (14–22) 6 (4–9)
22	SAQ	ED: sexual problem being decreased ability to achieve erection	NS	18, 23 31, 33 38, 43 48, 53 58–88[f]	2 (?)[c] 2 1 5 18
23, 24	SAQ	ED: erections of reduced rigidity, severely reduced rigidity or no erections possible No ED: erections of normal rigidity	NS	40–49 50–59 60–69 70–79 80+	9 (5–14) 29 (21–38) 57 (46–67) 79 (65–90) 86 (42–100)
25	SAQ	Moderate/complete ED: often experienced difficulties in getting and/or maintaining an erection during intercourse or intercourse does not succeed[d] Minimal/no ED: no erectile difficulties disturbing intercourse or occasional trouble in getting and/or maintaining an erection	NS	50 60 70	12 (10–15) 24 (21–28) 49 (44–53)
26, 27	SAQ	ED: difficulty in getting or maintaining an erection	3 months Lifetime	18–75 18–75	26 (23–30) 39 (35–42)
28	Interview	ED: trouble maintaining or achieving an erection	Year	18–29 30–39 40–49 50–59	7 (5–10) 9 (6–12) 11 (8–15) 18 (13–26)
29, 30	Interview	'Erectile disability': penis does not become rigid or gets flaccid during intercourse quite often, nearly all the time, all the time No erectile disability: penis does not become rigid or gets flaccid during intercourse never, hardly ever, quite rarely	Year	18–24 25–34 35–49 50–65 66–74	3 (1–6) 2 (1–4) 3 (1–4) 2 (1–4) 24 (17–33)
16, 31, 32	SAQ	ED: ability to have an erection when sexually stimulated none of the time/a little of the time[d] Minimal no ED: ability to have an erection when sexually stimulated some of the time—all of the time	Month	40–49 50–59 60–69 70–79	15 (6–28) 23 (14–35) 39 (30–49) 71 (59–82)
33, 34	SAQ	ED: usual quality of erections firm enough for masturbation and foreplay only, not firm enough for any sexual activity, no erections at all No ED: usual quality of erections firm enough for intercourse	3 months	40–49 50–59 60–69 70–79 80+	6 (3–11) 12 (6–19) 41 (29–53) 63 (49–76) 81 (54–96)

Table 4 cont.

Table 4 continued

Reference number	*SAQ/interview*[a]	*Definition of erectile dysfunction and severity when applicable*	*Time period*	*Prevalence rates (%)*	
				Age (y)	*Percentage (95% CI)*[b]
35	Interview	Partial/complete ED: some to all sexual performances considered unsatisfactory	NS	18–29	2 (1–5)[g]
				30–39	2 (1–4)
				40–49	5 (3–7)
				50–59	16 (12–20)
				60–69	27 (22–32)
				70+	48 (41–56)
36, 37	Interview	Moderate/severe ED: sometimes or never able to achieve and keep an erection good enough for sexual intercourse	NS	40–49	7 (5–9)
				50–59	22 (18–26)
		Mild/no ED: usually or always able to achieve and keep an erection good enough for sexual intercourse		60–70	49 (42–56)
38	SAQ	ED: recurrent inability to attain or maintain erections of sufficient rigidity for satisfactory sexual intercourse	6 months	50–54	26 (20–32)[g]
				55–59	35 (29–41)
				60–64	47 (40–53)
				65–69	60 (54–66)
				70–76	69 (62–75)
39	SAQ	Impotence: more than 17 points on ED-rating scale (see text)	NS	30–39	2 (2–3)[h]
				40–49	10 (8–12)
				50–59	16 (13–18)
				60–69	34 (32–37)
				70–80	53 (48–58)
40, 41	SAQ	ED: problems in achieving an erection, or maintaining an erection hard enough for sexual intercourse[i]	NS	40–49	6 (3–10)
				50–59	9 (6–12)
				60–69	22 (18–26)
				70–79	38 (32–44)
44	SAQ	Significant ED: erections of severely reduced rigidity or no erections	NS	50–54	3 (1–5)
				55–59	5 (3–8)
		Minor/no ED: erections of reduced/normal rigidity		60–64	11 (8–14)
				65–69	19 (14–23)
				70–78	26 (19–33)
45	SAQ	Moderate/severe/complete ED: considered moderate or severe/complete incapacity for erection[i]	NS[i]	25–39	2 (1–3)
				40–49	3 (2–5)
		Mild/no ED: considered minimum incapacity for erection or no erection problem		50–59	7 (5–10)
				60–70	21 (18–25)
46	Interview	Complete ED: never able to attain a penile erection sufficient for satisfactory sexual activity	NS	55–60	7 (?)[c]
				61–65	13
				66–70	22

[a]SAQ: self-administered questionnaire.
[b]CI confidence interval, estimated in current review.
[c]Prevalence presented by authors without CI, not reproducible.
[d]Definition made in current review.
[e]Only decades presented, information of five year cohorts omitted.
[f]Five year steps.
[g]Reproduced figures inconsistent with original report.
[h]Prevalence and CI presented by authors, not reproducible.
[i]Single question on ED.
NS: not specified.

Data collection in selected studies

Table 4 lists the methods used to obtain data on erectile function and the definitions used for ED. In 17 studies self-administered questionnaires were used, six studies used an interview, and in five studies the methods used were not specified.

Various questionnaires were used to assess ED in the population. These questionnaires contained either a single question on ED,[7–9,14–20,22–24,29–35,40–45] or a series of questions on ED from which a sum score was derived.[39–41,45]

In two studies, two methods were used to determine ED, ie, a single question on ED and a larger questionnaire.[40,41,45] In the MMAS, a calibration study was used to determine impotence from answers to imprecise questions on sexual function.[10] In the first reports on ED, a urological clinic sample was used for this purpose ('clinical method'),[10] whereas in later reports on the longitudinal data, the study sample itself was used ('MMAS

method').[12] These two methods resulted in different prevalence rates.[12]

Definition of erectile dysfunction

No definition of ED was specified in one report, whereas four studies defined 'impotence', and three studies defined 'erectile difficulty', 'erectile disability' or 'erection problems'. In the remaining 16 studies a definition of ED was given (see Table 4).

Prevalence of erectile dysfunction

Prevalence rates varied considerably (Table 4). All studies showed a linear increase in prevalence with advancing age. In two studies no age-specific prevalences were given.[8,9,26] Prevalence rates for men younger than 40 y old (reported in six studies) ranged from approximately 2 to 9%. The prevalence rate for men older than 70 y (reported in 13 studies) ranged from 10 to 71%, whereas for men older than 80 y (reported in three studies) prevalence ranged from 18 to 86%.

Direct comparison of prevalence was possible for only two pairs of studies. Reported prevalences in the Olmsted County Study (OCS)[14–16] and the Japanese survey[32] were roughly similar and showed a large increase in prevalence after the age of 70. The reported prevalences in Leicestershire (UK)[23] were considerably higher for the older age groups (60–69 and 70–79 y) than those from Krimpen aan den IJssel (The Netherlands);[43,44] in this comparison, in the Dutch study all ED severity categories were combined, because the UK study did not provide information on the separate ED severity categories.

Discussion

This is the first systematic review of the literature focussing on the prevalence of erectile dysfunction in the general population. Previously, available data in this rapidly growing epidemiological field of research were summarized nonsystematically,[1–5,47–54] or without a focus on the general population.[55] In particular, no information about the selection of included studies was provided,[1–5,47–54] and the validity of the included studies was not discussed by the authors.[1–5,47–55] In the current study, an overview of the available literature is given and a quality assessment of individual studies is presented, according to proposed guidelines for reporting of systematic reviews.[56,57]

Selection of studies and data extraction

Only two studies were found via the reference lists, suggesting that the primary search strategy was sufficient. Studies reported in books were not included in the current review. We decided not to contact authors of the selected studies as this could introduce a bias; authors of recent studies may be easier to contact, and information may be more easily available than from older studies. Overall, we believe that information should be readily available to be used by readers of articles.

Methodological quality assessment

As no criteria list for the methodological quality assessment of prevalence studies was available, we developed such a list based on theoretical considerations and common sense (Table 1), which can also be used for a systematic review of the prevalence of other conditions in the general population.

The distinction made between valid and invalid based on overall scores, and the use of cut-off points is arbitrary. It should be recognized, however, that some of the selected studies have a high number of negative scores (Table 2). In itself, a study may be valid, but if the reporting is inaccurate, the comparability with other studies and its use in a systematic review will be restricted.

Besides the overall quality assessment, several remarks can be made on separate validity criteria, such as the representativeness of the study population (item *d* in the quality assessment). In 11 studies, the response rate was lower than 70% and insufficient data were available on the representativeness of the population. In two of these studies, the low response rate may be explained by the high effort required from the participants or the inclusion of additional measurements.[23,31,32] Surprisingly, in six studies, no information was given on the study period.

Definitions of ED and questionnaires

Although various authors refer to the consensus definition of ED — 'inability to attain and maintain an erection sufficient for satisfactory sexual activity'[58] — in their reports, only two actually used it in the estimation of prevalence rates.[36–38] The design of a questionnaire may influence the prevalence rates obtained from it; for example, the ED-rating scale in the Cologne ED Questionnaire consists of five closely related questions;[39] a positive score on one question will almost automatically mean a

positive score on another question. Moreover, the ED-rating scale included a question on the ability to achieve orgasm;[39] this construction may cause a significant overestimation of the prevalence of ED.

The use of a urological clinic sample for the calibration study in the MMAS has led to an overestimation of the prevalence of ED, which was described in a later paper on this study.[12] In the longitudinal part of the MMAS, a single question on ED was added to the questionnaire, resulting in lower prevalences, especially for those of moderate to severe impotence.[12,13]

In 14 studies, a single question was used to obtain information on erectile function; however, none of these questions was formally validated. Recently, two studies showed that a single question on ED could be used in epidemiological surveys, but the precise formulation of such a question was not discussed.[13,45] Nevertheless, we assume that, when properly specified, the single questions used in other studies provide valid information.

Comparison of prevalence rates

The current review shows that the reported prevalences of ED vary considerably and that there are major methodological differences between studies. Therefore, it is unclear whether these varying prevalences reflect true differences between countries or methodological differences. In our opinion, the large methodological variations, especially the different definitions used, hamper the direct comparison of prevalence rates reported in most studies. Only a few studies can be meaningfully compared.

For example, the similar designs of the OCS and the Japanese study do allow comparisons to be made.[14–16,31,32] In the reports of the OCS,[14–16] however, no exact prevalence rates of ED are given, other than the cumulative distribution of the responses to the specific questions, in the combined report of both studies.[32] We derived the prevalences from this latter report: that 44% (109 out of 245) of these men reported to have '*erections none of the time*'.[32] Surprisingly, this prevalence is not in accordance with an earlier report from that study in which the authors state that '*the percentage of subjects who were able to have erections a little or none of the time increased . . . to more than a quarter of men aged 70 or older*'[14]

The studies from Leicestershire (UK) and Krimpen aan den IJssel (The Netherlands) used the same definition and questionnaire (International Continence Society *male sex* questionnaire).[23,44] Differences in risk profiles and different perceptions of the problem may both contribute to the dissimilarities in reported prevalence of ED between men aged 60 and over; further studies are needed to explain these differences.

Previously, it was concluded that the considerably lower prevalences in Spain (compared with the MMAS data) might be attributed to differences in perception of ED across different cultures.[45] In our opinion however, these differences are more likely caused by differences in the questions that were used (see Table 3).

Several conclusions can be drawn from this systematic review of the literature on the prevalence of erectile dysfunction in the general population. First, the information in many of the reports is insufficient to provide valid data on prevalence rates and can therefore not be generalized or used to draw conclusions from comparisons with other studies. Second, the methods used to obtain information on erectile function vary considerably. Differences in definitions (derived from various questionnaires) are the main hindrance to comparing reported prevalences. Third, in those studies that are similar, specific data on age-specific and severity-specific prevalences of ED are scarce, as is the information on comorbidity in these study populations.

When reporting on prevalences of ED, we stress the importance of describing all information relevant for the interpretation of the data. Future studies should aim to clarify whether reported differences in prevalences are due to methodological differences only, or may be attributed to cultural or other factors. Large international cohort studies appear to have the most appropriate design to address these questions, but re-analysing the raw data from available prevalence studies, as described in this review, may also be appropriate.

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