The Impact of Aging on Sexual Function and Sexual Dysfunction in Women: A Review of Population-Based Studies

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ABSTRACT

Introduction. Scientific interest in the impact of aging on women's sexual function and dysfunction has increased in the half century since Kinsey described age-related changes in women's sexual activities. However, a range of methodological issues limit the conclusions that can be drawn from many published studies in this area.

Aim. To review community-based studies investigating changes in women's sexual function and sexual dysfunction with age, taking into account confounders to aging and methodological limitations.

Methods. Electronic databases were searched for published studies investigating changes in sexual function and dysfunction with age. A critical review was carried out.

Main Outcome Measures. Age-related changes in sexual function and dysfunction.

Results. There are inconsistencies in the way sexual function and sexual dysfunction are measured. Validated scales are infrequently used. Low response rates, limited age ranges, and restrictive inclusion criteria limit the generalizability of many studies. Confounders are often either not measured or not analyzed. Longitudinal studies are rare, making it difficult to separate the effects of birth cohort and aging. The evidence indicates that a woman's sexual function declines with age. This decline begins in a woman's late 20s to late 30s. Specifically, desire, frequency of orgasm, and frequency of sexual intercourse decrease with age. However, it is not clear whether arousal decreases or remains relatively constant. In longitudinal studies, decline in women's sexual function has also been detected, but patterns of stability and improved sexual function have also been observed for short periods of time. The prevalence of most sexual difficulties or dysfunctions changes little with age, with the exception of sexual pain, which may decrease.

Conclusions. Age-related changes in sexually related personal distress may help explain why the prevalence of sexual dysfunctions remains constant with age while sexual function declines. More research is needed to demonstrate this.

Key Words. Female Hypoactive Sexual Desire Disorder; Female Sexual Arousal Disorder; Female Orgasmic Disorder; Female Epidemiology

Introduction

Aging encompasses a range of processes that have the potential to affect a woman's sexual function. Hormonal and physiological changes take place throughout a woman's life. These changes are particularly pronounced during puberty, menstrual cycles, pregnancy, postpartum, and the menopausal transition. Relationship factors including the presence of a partner, the partner's age and sexual function, the length of the relationship, and a woman's feelings for her partner may change as a woman ages. The importance of sex in her life and level of distress she

feels if she suffers from sexual dysfunction may also differ as a consequence of her age. This review explores the changes in sexual activities, sexual function, and sexual dysfunction that occur as a woman ages. The focus is on community-based studies. Important confounders to aging and methodological limitations of published studies are examined.

Focus of Studies

The focus of many studies that yield data in this area is not sexual function or dysfunction per se. Due largely to the HIV epidemic, a sizeable proportion of the research in this area is dedicated to exploring sexual risk behaviors. This is particularly true of cross-sectional studies. Many studies attempt to cover a broad range of sexual behaviors, knowledge, and practices, and are principally aimed at documenting the extent of these behaviors and investigating the spread of sexually transmitted infections [1,2]. Presumably, because of the large number of questions included in these investigations, sexual difficulties often end up being addressed by a single question for each dysfunction rather than by a validated instrument. The menopausal transition is another major focus of cross-sectional and longitudinal studies. Sexual function and age-related data derived from these studies suffer because of the limited age range included and sometimes because of the exclusion of certain groups of women such as those who have had a hysterectomy or ovariectomy, or those who are taking medications that affect their hormone levels [3–5]. Often the data presented in these studies are analyzed by menopausal status rather than by age [6]. Clinically based studies are another major category of research into sexual function and dysfunction. Sometimes these studies investigate women suffering from a particular illness where sexual function is one of the outcomes under investigation [7]. Such studies focus on particular subgroups that are not representative of the general community and will not be discussed here.

Confounders

Given that so many changes take place in a woman's life as she ages, it can be challenging to separate out which factors affect which aspects of her sexual function and to what degree. One of the major deficiencies in the literature is that many of the relevant determinants of sexual function are not measured or analyzed to separate out their effects [8]. Among these variables that are infrequently investigated are a number of relationship issues. These include changes in partner status, feelings for partner, partner aging, partner sexual function, length of the relationship, and whether the responses given are partner-specific. Most studies do not record hormone levels [9,10], and very few investigate attitudes and psychological changes over time such as the relative importance of sex and sexually related personal distress [11]. Prior level of sexual function is an important determinant of current sexual function [12] that is also rarely investigated.

Measuring Aging

Age ranges investigated vary from highly focused, covering a very small number of years where the aim is to investigate a particular stage in a woman's life, to a very broad age range spanning youth to old age. Frequently, age is used as a categorical variable [13,14] rather than a continuous one [5]. This is a simpler form of analysis, but statistical power is lost when the data are analyzed in this way. Also, if age intervals differ between studies, it makes comparisons between studies more difficult [10,15]. Most studies investigating sexual function do not include women under the age of 35 years [3,11,16–19]. This limits our ability to determine how early in a woman's life changes in sexual function begin.

New Definitions of Sexual Dysfunction and Personal Distress

New definitions of sexual dysfunctions have been developed which include personal distress as part of the definitions for vaginismus, desire, arousal, and orgasmic disorders [20]. Only recently have validated measures of distress been developed [21]. Studies published prior to the development of these definitions, for the most part, do not formally take into account personal distress. In addition, the new definitions also allow sexual difficulties that result from the full range of causes to be included as dysfunctions, whereas previously those that were the result of a substance (drug) or a medical condition were not included (DSM-IV) [22]. As a consequence, in some studies sexual problems that result from substance use or a medical condition have been excluded from the sample or analysis [23]. This is an important change with respect to sexual dysfunction and aging as both

medical conditions and medication use increase with age and so have the potential to exert a greater effect on sexual function.

Validation of Outcome Measures

There is a great deal of inconsistency in the ways in which sexual function and dysfunction have been assessed. A surprisingly small number of studies use scales that have been validated to determine their reliability and ability to discriminate sexual function from sexual dysfunction. Often, sexual dysfunction is assessed by a single unvalidated question [24]. Whether single-item questions produce comparable results to multi-item scales in this area of research is an important question that requires further research. In general, multi-item scales are more reliable than single item questions [25,26]. In addition, multi-item scales are needed where there is an underlying conceptual entity with a number of facets that may not be covered by a single question [27]. Sexual arousal disorder is a good example. This concept includes a lack of subjective excitement, a lack of genital lubrication/swelling, or a lack of other somatic responses [20]. A single question would be insufficient to address all of these aspects. One of the most important deficiencies in using a single-item question to assess whether a woman has a sexual dysfunction is that with this method we cannot measure the relative contributions of distress versus poor function separately, or determine whether one or both components have been included in a participant's response. Adding to the difficulties in assessing sexual function and dysfunction is a strong correlation between desire, arousal, and orgasm [12] and a known comorbidity between the associated dysfunctions [20], making it difficult to discriminate between these concepts.

Generalizability

In a number of studies investigating changes in women's sexual function and dysfunction with age, there are deficiencies in design and sampling that affect how well we can generalize from these investigations to the community at large. These problems relate to response rates, sampling strategies, age ranges, and inclusion criteria. A number of cross-sectional studies have relatively low response rates (50–70%) [11,13,28], and some have response rates that are extremely low (Bretshneider and McCoy 1988, Bergstrom-Walen and Nielsen 1990, both around 30%) [16,29]. In some cases this effect is compounded by a low response rate to the particular questions that address sexual function and dysfunction. Low response rates may be due, in part, to difficulties in conducting community-based surveys of this kind and the personal nature of sexually related questions. Longitudinal studies often take a sample from cross-sectional studies, and the percentage of the participants remaining decreases with this extra step. As follow-up continues, the numbers retained diminishes, adding further to problems of generalizability. We can expect that the remaining sample may be biased toward individuals who are sexually active, healthy, and have liberal attitudes toward sex. The use of small convenience samples poses similar problems, particularly when recruitment occurs via advertisements [4]. Women who have not been sexually active for a particular period of time prior to the study are often excluded [8,9]. Sexual inactivity increases with age, but it may also be a response to sexual difficulties, so this group is a significant omission. The end result may be a sample that is not truly representative of women in the general community. Caucasian women make up the majority of respondents in many studies in this area [16,17,30,31], so conclusions from these studies will not necessarily apply to non-Caucasian populations.

Time Frames

The duration of sexual dysfunction or difficulty investigated is not consistent across studies. This affects the prevalence of sexual dysfunction reported and makes comparing studies investigating the effect of age more difficult. Studies that ask respondents to report dysfunctions or difficulties that lasted for shorter periods of time will generally give a higher prevalence. A good example of this can be seen if we compare studies by Laumann et al. (1999) [10], Najman (2003) [24], and Richters et al. (2003) [9]. All three are relatively large cross-sectional, community-based studies. The questions regarding sexual difficulties are almost identical across the three studies except that Richters et al. changed the duration of sexual difficulty investigated from several months or more in the last year to 1 month or more in the last year. This had a dramatic effect on the prevalence of sexual difficulties reported. For example, Laumann et al. and Najman et al. reported a prevalence of lack of interest in sex of 34% and 32%, respectively, among women aged up to 59 years, while Richters et al. reported a prevalence of 55%

in this same age group. There was a similar difference in the prevalence of other sexual difficulties, and this difference was observed across age groups. This cannot be explained by differences in the populations as the studies by Najman et al. and Richters et al. both investigated random samples of the Australian population. A British study by Mercer et al. (2003) [32] compared sexual difficulties of different duration and reported that difficulties that lasted for a greater length of time showed a lower prevalence. Another factor that affects the reported prevalence is the time span over which investigators search for periods of sexual difficulty. The greater this time span, the more likely a sexual difficulty will be found. Studies that ask about dysfunctions experienced in the previous month [33] report a lower prevalence than studies that ask women if they have had a sexual dysfunction that lasted for 1 month at some time over the last year [9].

Cross-Sectional and Longitudinal Study Designs

With both cross-sectional and longitudinal study designs, there are advantages and limitations for investigating the changes that occur as a woman ages. Cross-sectional studies have the advantage of allowing a broad range of ages to be investigated with relative ease. However, in cross-sectional studies the effects of age and cohort membership are inevitably confounded [31]. One of the advantages of longitudinal studies is that the effects of age and cohort membership can be examined separately. Longitudinal studies are also useful because they allow us to examine both aggregate trends and intraindividual patterns of change. We can observe patterns of constant, declining, and increasing sexual function within the one sample. It is also possible to separate suspected causes and effects in time, which provides stronger evidence for causation. The length of follow-up is usually limited for practical reasons. In the area of women's sexual function and dysfunction, the stage of life investigated is generally limited to the years around the menopausal transition. For these reasons it can be difficult to establish if the change in sexual function is an exception or consistent with the overall pattern of sexual function in a woman's life. One of the main problems in the literature on sex and aging is that there are very few longitudinal investigations. In addition, for many of these studies, either the recording or analysis of data relating to aging is cross-sectional rather than longitudinal [34].

Methods

Search Strategy

The following electronic databases were searched: Ovid Medline (1966–2004), ISI Current Contents (1994–2004), Biological Abstracts (1980–2001), PubMed (1950–2004), ISI Web of Science (1945–2004), and CSA PsychINFO (1950–2004). The search terms used were: sexual function/functioning, sexual dysfunction, sexual difficulty/difficulties, woman, women, female, age, aging, ageing. In addition, a hand search for relevant references quoted within articles was undertaken, and these references were obtained. The references obtained in this way included both journal articles and books.

Inclusion Criteria

Included in this search were community-based cross-sectional and longitudinal studies that incorporate questions on sexual function or difficulties and where the effect of age has been examined. Studies based on convenience samples, with an overall response rate of less than 50%, a sample size of less than 100, or those where the sampling procedure, response rate, or sample size were not reported have been excluded. Clinic-based studies (including those drawn from general practice registers) and those restricted to women with a particular medical condition were also excluded. Tables 1 and 2 summarize the studies.

Results

Tables 1 and 2 describe the main details of the published population-based studies that investigate the impact of aging on sexual function and sexual dysfunction in women. The principal authors, year of publication, location of study, and study name (if reported) are listed. The sample size and age range of respondents are indicated. Details of how respondents were admitted into each study, including the sampling procedure, response rate, and inclusion criteria, are described. The relevant aspects of the outcome measures used in the study are described. These include the procedure (particularly whether respondents were interviewed or given a questionnaire) and the time frame over which the outcomes took place. The names of any instruments used to measure the outcomes and references that describe the questions used or their validation are listed under "source of questions." Results pertaining to age-related changes in sexual activities, sexual

Table 1 Cross-sectional studies

Study	Sample	Admission	Measures	Results	Limitations
Hallstrom 1977 [3] Location: Sweden "The Gothenburg Study"	N = 800 Age 38–54 years	**Sampling:** stratified random sample of women aged 46, 50, 54 years from the industrial town of Gothenburg, Sweden. **Response rate:** 89%. **Inclusion criteria:** women with both ovaries removed, X-ray castration, hysterectomy, or taking contraceptive pill were excluded.	**Procedure:** interview in Swedish. **Time frame:** current and last 5 years. **Source of questions:** Hallstrom 1973 [52].	**Sexual activities:** frequency of coitus declined with age. **Sexual function:** current sexual interest and proportion of orgasms with coitus declined with age. With increasing age, more women reported that sexual interest or orgasms with coitus had declined over the last 5 years, and fewer reported these had increased. Large proportion reported that sexual interest or orgasms with coitus had not changed over the last 5 years.	Limited age range, length of relationship, and personal distress not examined. Validation of questions not reported.
Lunde et al. 1991 [31] Location: Denmark	N = 625 women Age 22, 40, 70 years	**Sampling:** stratified population sample from birth registry. Born 1958, 1936, 1910. **Response rate:** 66%, 94%, 60%, respectively. **Inclusion criteria:** no exclusion of respondents reported.	**Procedure:** interview with open-ended questions. **Time frame:** at least once in your life. **Source of questions:** not reported.	**Sexual experiences:** percentage of women who had never experienced orgasm was greatest in oldest cohort. Spontaneous sexual desire, desire after stimulation highest in the youngest cohort. Lowest age when first recognized desire, age of first orgasm in youngest cohort. Ever masturbated highest in youngest cohort.	No investigation of current sexual functioning.
Laumann et al. 1994 [2], 1999 [10] (study conducted in 1992) Location: U.S.A.	N = 1,749 women Age 18–59 years	**Sampling:** national probability sample of the general population. **Response rate:** 79%. **Inclusion criteria:** sexually active in the prior 12-month period. People living in group quarters such as barracks, college dormitories, and prisons and those who did not know English well enough to be interviewed were excluded.	**Procedure:** interviewed in person. Individual questions assessed sexual difficulties. **Time frame:** having experienced a sexual difficulty for period of several months or more over the previous 12 months. **Source of questions:** developed by authors assisted by expert panel.	**Sexual activities:** prevalence of having masturbated in the last year was low in the youngest and oldest cohorts, and a plateau was observed in the middle years. Number of women who reported having masturbated once a week decreased with age. Number of women reporting having sexual activity with a partner peaked in the 25–29-year-old age bracket (93%), then gradually declined until the 50–54-year-old age group (82%), then declined more rapidly to 60% in the 55–59-year-old age group. **Sexual difficulties:** lack of interest in sex, inability to achieve orgasm and trouble lubricating did not change with age. Pain during intercourse, sex not being pleasurable and anxiety about sexual performance decreased with age.	Length of relationship and personal distress not examined. No validation of questions reported.
Spira and Bajos 1994 [1] Location: France	N = 11,104 women Age 18–69 years	**Sampling:** random selection of households with telephones in France. **Response rate:** 72%. **Inclusion criteria:** homes that were main residence and where there was at least one French speaker.	**Procedure:** telephone survey in French. Satisfaction was measured by a single question. **Time frame:** "current" not further defined. **Source of questions:** developed by the researchers.	**Satisfaction:** satisfaction decreased with age.	Length of relationship and personal distress not examined. No validation of questions reported.

Table 1 Continued

Study	Sample	Admission	Measures	Results	Limitations
Dennerstein et al. 1994 [41] Location: Australia	N = 2,001 women Age 45–55 years	**Sampling:** random sample of the community from the Melbourne telephone directory. **Response rate:** 71%. **Inclusion criteria:** born in Australia.	**Procedure:** structured telephone interview. **Time frame:** prior 12 months. **Source of questions:** developed from discussions with a community consultative committee.	**Sexual function:** sexual interest over the last 12 months—62% remained constant, 31% decreased, and 7% increased (majority of these had new partner). Decrease in sexual interest was not associated with young age.	Length of relationship and personal distress not examined. No validation of questions reported.
Kontula and Haavio-Mannila 1995 [36], 1997 [53] Location: Finland	N = 1,146 women Age 18–54 years	**Sampling:** random sample from the general population. **Response rate:** 78%. **Inclusion criteria:** no exclusion of respondents reported.	**Procedure:** interview and self-administered questionnaire. **Time frame:** past week/past month. **Source of questions:** developed by researchers.	**Sexual activities:** the percentage of women who had engaged in sexual activities, including masturbation, decreased as a result of both age and the length of the relationship. Finding sexual intercourse pleasurable was associated with age.	Sexual dysfunction and personal distress not examined.
Barlow et al. 1997 [13] (study conducted in 1993) Location: Britain	N = 2,045 women Age 55–85+ years	**Sampling:** nationally representative quota sample of British women. **Response rate:** 62%. **Inclusion criteria:** passing a memory test.	**Procedure:** structured interview in participants home. Sexual difficulties were measured as presence/absence. **Time frame:** past 2 years for sexual difficulties, past 1 year for sexual activities. **Source of questions:** not reported.	**Sexual activities:** overall frequency of sexual activity decreased with age, penetrative sexual activity decreased with age, sexual activity of women with partners decreased with age. 73% reported having no sexual intercourse in the past year. **Sexual difficulties:** pain during intercourse decreased with age.	Low response rate. Length of relationship and personal distress not examined. No validation of questions reported.
Ventegodt 1998 [38] Location: Denmark	N = 753 women Age 18–88 years	**Sampling:** systematic sample (by date of birth) of the Danish population. **Response rate:** 60.7%. (includes male responders). **Inclusion criteria:** no exclusion of respondents reported.	**Procedure:** anonymous postal questionnaire. Single question assessed intensity of satisfaction. Sexual difficulties were selected from a list of problems. **Time frame:** current. **Source of questions:** not reported.	**Sexual difficulties:** desire problems and inability to achieve orgasm did not change with age. **Sexual satisfaction:** did not change with age.	Low response rate. Length of relationship and personal distress not examined. No validation of questions reported.
Fugl-Meyer and Fugl-Meyer 1999 [14], 2002 [45], 2003 [28], 2004 [51] (Conducted 1996) Location: Sweden "Sex in Sweden"	N = 1,335 women Age 18–74 years In second analysis N = 1,056 women Age 18–65 years	**Sampling:** national random sample of the Swedish population. **Response rate:** 59%. **Inclusion criteria:** ability to communicate in Swedish and sexually active over the last 12 months. Those whose mental or physical health was too poor to participate were excluded.	**Procedure:** questionnaire filled in by respondent during face-to-face interview in Swedish. Individual questions assessed the frequency each sexual difficulty. **Time frame:** year prior to study. **Source of questions:** not reported.	**Sexual difficulties:** first analysis: reduced sexual desire, reduced sexual interest, lubrication disability and dyspareunia increased with age. Orgasm disability, vaginism did not change with age. In the second analysis: lubrication problems increased with age, low sexual interest, low orgasmicity, pain during intercourse, and vaginismus did not change with age. **Sexual satisfaction:** decreased with age. **Length of relationship:** in the youngest cohort (18–34 years) sexual desire and interest decreased with the length of the relationship. Among 50–65-year-old women desire decreased with the length of the relationship. **Problems:** 43–69% (depending on the "disability") of those with sexually disabilities perceived them as problems. The proportion of women who perceived their sexual disability as a problem did not change with age.	Low response rate may reduce generalizability of results. Personal distress not formally measured.

Table 1 Continued

Study	Sample	Admission	Measures	Results	Limitations
Kadri et al. 2002 [8]. Location: Morocco	N = 728 but 491 included for sexual difficulties analysis. Age 20–80 years	**Sampling:** stratified (by age and precinct) random sample of general population in Casablanca. **Response rate:** 91%. **Inclusion criteria:** women who were not sexually active were not included for sexual difficulties analysis.	**Procedure:** face-to-face interview in Moroccan Arabic. Frequency of sexual difficulties based on single question for each difficulty Women who answered always or often to these questions were defined as having that dysfunction. **Time frame:** in the previous 6 months. **Source of questions:** questions from DSM criteria 1994.	**Sexual difficulties:** HSDD decreased with age. Sexual aversion, orgasm difficulties, sexual arousal difficulties, and dyspareunia did not change with age.	Length of relationship and personal distress not examined. No validation of questions reported.
Bancroft et al. 2003 [33] Location: U.S.A.	N = 987 Age 20–65 years	**Sampling:** stratified random national sample. Black women were oversampled to ensure white to black ratio of two. **Response rate:** 53.1%. **Inclusion criteria:** English as first language, living for at least 6 months in a heterosexual relationship.	**Procedure:** computer-assisted telephone interviewing. Distress: "distress about ones own sexuality" and "distress about the relationship" using single question for each. Intensity of distress (none, slight, moderate, a great deal). **Time frame:** during the past 4 weeks. **Source of questions:** Interview Ratings of Sexual Function (Bancroft et al. 1982) [52]. Tested for interrater reliability.	**Sexual difficulties:** lubrication problems and impaired physical response did not change significantly with age. **Sexual function:** thinking about sex with interest decreased with age. **Personal distress:** distress about the relationship and ones own sexuality increased in some comparisons.	Low response rate. Restricted to women living in relationships. Did not examine length of relationship.
Najman et al. 2003 [24] (study conducted 1999–2000) Location: Australia	N = 908 women Age 18–59 years	**Sampling:** stratified (by age) random sample from the Australian electoral roll **Response rate:** 61%. **Inclusion criteria:** no exclusion of respondents reported.	**Procedure:** telephone interview survey. Sexual difficulties were assessed by individual questions. **Time frame:** having experienced a sexual difficulty for period of several months or more over the previous 12 months. **Source of questions:** Laumann et al. 1994 [2].	**Sexual difficulties:** pain during intercourse decreased with age, trouble becoming lubricated, and not finding sex pleasurable increased with age. The 30–39-year-old age group reported the most lack of interest in sex. 40–49-year-olds felt least anxious about sex. Inability to reach orgasm and achieving orgasm too quickly did not change with age.	Low response rate. In the analysis with age, it is not clear which age groups are being compared to give significant results. Length of relationship and personal distress not examined. No validation of questions reported.

Table 1 Continued

Study	Sample	Admission	Measures	Results	Limitations
Richters, Rissel et al. 2003 [9,35,37] Location: Australia "Australian Study of Health and Relationships"	N = 9,134 women Age 16–59 years	**Sampling:** random sample of general population with oversampling of residence of some geographical areas. Sample adjusted to fit Australia's population (to give N = 9,578). **Response rate:** 77.6%. **Inclusion criteria:** sexually active (in masturbation or with partner).	**Procedure:** computer-assisted telephone interview. **Time frame:** having experienced a sexual difficulty for period of at least 1 month over the previous 12 months. **Source of questions:** modified version of Laumann et al. 1994 [2].	**Sexual difficulties:** lack of interest in sex, inability to reach orgasm, and trouble with dryness increased with age. Pain during intercourse and worrying about attractiveness during sex decreased with age. Not finding sex pleasurable, anxiety during sex, achieving orgasm too quickly did not change with age. **Sexual activities:** frequency of sexual activity with regular sexual partner decreased with age from 30 onwards (from 2.2 to 1.3 times per week in oldest age group). Proportion of women having masturbated alone in the last year increased from 24% in the 16–19-year-old age bracket to 43% in the 20–29. Plateau was observed between 20 and 39 years of age and then steadily decreased from 40 years to 26% in the 50–59-year-old age brackets. Women with a live-in regular partner were significantly less likely to have masturbated in the last year than women with no regular partner.	No validation of questions reported; length of relationship and personal distress not examined.
Johnson et al. 2004 [23] (conducted 1981–1983) Location: U.S.A.	N = 1,801 women Age 18–96 years	**Sampling:** residents in designated localities in the St. Louis area. Random sample generated using the Kish method (Kish 1965) [55]. **Response rate:** 87%. **Inclusion criteria:** excluded dysfunction due to medical condition or medication.	**Procedure:** interview. **Time frame:** months/two months or more/several months over a lifetime. **Source of questions:** DIS Diagnostic Interview Schedule with single question for each difficulty.	**Sexual difficulties:** (male and female data combined) those aged 45 years and over were compared with those younger than 45 years. Inhibited sexual excitement increased with age. Dyspareunia decreased with age. Inhibited orgasm, inhibited sexual desire or "any sexual dysfunction" did not change with age.	Male and female data combined, excluded dysfunctions resulting from medical condition or medication (these categories would be included under the new definitions of FSD). No validation of questions reported, length of relationship and personal distress not examined.
Gracia et al. 2004 [34] Location: U.S.A. "Penn Ovarian Aging Study"	N = 326 women Age 35–47 years	**Sampling:** population sample of Philadelphia County obtained through random digit dialing. **Response rate:** 75%. **Inclusion criteria:** 35–47 years of age, regular menstrual cycle for 3 months prior to the study, intact uterus, and at least one ovary. Women who had serious illness which could affect hormones, taking hormones in the last 3 months, pregnant, lactating, using psychotropic medications having "abused" alcohol or illicit drugs (not further specified) in the last year were excluded.	**Procedure:** participants were "visited," and a questionnaire was "administered." Sexual difficulties: assessed by single question regarding presence or absence of "decreased libido or interest in sex". **Time frame:** past month, asked only at final visit. **Source of questions:** not reported.	**Sexual difficulties:** decreased libido did not change with age (measured as age at final visit).	Although the study overall is longitudinal, the data for libido are cross-sectional because they were only assessed at final visit. Exclusions reduce generalizability. Length of relationship not included. Personal distress not included. Validation of questions not reported. Limited age range and difficulty separating menopause and age effects.

HSDD = hypoactive sexual desire disorder; FSD = female sexual dysfunction.

Table 2 Longitudinal studies

Study	Sample	Admission	Measures	Results	Limitations
Hallstrom and Samuelsson 1990 [40] (study conducted 1968–1975) Location: Sweden "Gothenburg Study"	N = 497 women Age 38–54 years, then 44–60 years	**Sampling:** stratified random sample of women from the industrial town of Gothenburg, Sweden aged 38, 46, 50, 54 at first interview and 44, 52, 56, 60 at second interview. **Inclusion criteria:** married on both. occasions when interviewed or cohabiting with a male partner. **Response rate:** 89%. **Follow up:** 6 years, two assessments. **Retained:** 75%.	**Procedure:** interview in Swedish. Sexual functioning: intensity of desire (strong, moderate, weak and absent). Sexual difficulties: HSDD—defined as absent desire. **Time frame:** "present". **Source of Questions:** Hallstrom 1973 [52].	**Sexual function:** decrease in desire from first to second interview was significantly associated with age. A change in sexual desire was reported by 37% (27 % had a decrease, 10% an increase). 63% showed no change in sexual functioning. **Sexual difficulties:** HSDD increased with age cohort. **Partner factors:** decrease in sexual desire predicted by lack of a confiding relationship, insufficient support from spouse, alcoholism in spouse. Increase in sexual desire predicted by negative marital relations before first interview. **Other factors:** decrease in sexual desire predicted by high sexual desire at first interview, and major depression. Increase of sexual desire predicted by weak desire at first interview, and mental disorder at first interview.	Data on sexual difficulties is cross-sectional. Length of relationship and personal distress not included. Limited age range. Validation of questions not reported.
Koster and Garde 1993 [39] Location: Denmark	N = 474 women Age 40–51 years	**Sampling:** random sample of women born in 1936. **Inclusion criteria:** residents in specific municipalities in Copenhagen. **Response rate:** not reported. **Follow up:** 11 years, 3 assessments. **Retained:** 76%.	**Procedure:** interview on first two assessments and postal questionnaire on final assessment. **Time frame:** not specified. **Source of questions:** Garde and Lunde 1980 [56].	**Sexual function:** frequency of desire unchanged for majority 59%, decreased in 30%, and increased in 10%. Frequency of desire was correlated with former sexual activity, partner availability, social status, health status, anticipation of decreased desire.	Unclear if frequency of desire is longitudinal or cross-sectional data. Length of relationship and personal distress not examined. Limited age range. No validation of questions reported.
Dennerstein et al. 2002 [5] Location: Australia, 1991–1999	N = 438 (226 for repeated measures) Age 45–55 years	**Sampling:** random population-based sample. **Inclusion criteria:** still menstruating at baseline (menses in the last 3 months). Not taking oral contraceptives or HT. Not had surgical menopause during study. **Response rate:** 71% to cross-sectional, then 56% to longitudinal. **Follow-up:** 8 years assessed annually. **Retained:** 88%.	**Procedure:** self-administered questionnaire with field worker present. **Time frame:** previous month. **Source of questions:** Short personal experiences questionnaire (SPEQ) validated and based on McCoy Female Sexuality Questionnaire [57].	**Sexual activities:** frequency of sexual activities decreased with age. **Sexual function:** total SPEQ score decreased with age, sexual responsivity, and libido decreased with age. **Other factors:** Positive mood increased with age, and negative mood decreased with age.	Limited generalizability because women were excluded. Length of relationship and personal distress not examined. Limited age range.

HSDD = hypoactive sexual desire disorder; HT = hormone therapy.

function, and sexual difficulties are given in the tables. Where sexual satisfaction, the importance of sex, or sexually related distress have been analyzed by age, these results have also been given. If important confounders such as partner issues and the length of the relationship were investigated, these are included in the tables. Limitations of these studies are also described. In Table 2, which describes longitudinal studies, the length of follow-up and the percentage of respondents retained in the study are also reported.

Cross-Sectional Studies

Most cross-sectional studies report a decline in sexual function and the frequency of sexual activities with age. This decline appears to begin when a woman is aged somewhere between her late 20s and late 30s [2,14,33,35]. There have been many reports of the frequency of sexual activities declining with age [2,3,10,13,35,36]. Sexual intercourse is the activity most commonly described [3,13,36]. There is also a decline in the number of women who remain sexually active with increasing age, particularly in older age groups [2,13]. Research investigating women's masturbation frequency indicates that the frequency of masturbation increases from the teen years through to the early 20s, after which it plateaus until around the mid 40s and 50s when it starts to decline [2,37]. Women without a regular partner are also more likely to report having masturbated at all over the previous year [37]. There is general agreement in the literature that with increasing age there is a decline in desire and sexual interest [3,31,33]. The frequency with which women experience orgasm also decreases with age [3]. Research into changes in arousal with age is very limited. In the initial search of the literature, reports of arousal both decreasing with age [15] and remaining constant [11] were found. However, these studies were not of a sufficient standard to be included in the tables.

The prevalence of most sexual difficulties and dysfunctions remains fairly constant with increasing age. Problems with sexual desire or interest mostly show no relationship with age [10,23,28,34,38]. There have been a few reports of problems of sexual desire increasing [9,14] and decreasing with age [8]. Difficulties in achieving orgasm generally show no association with age [8,10,14,23,24,28,38] with only a rare exception [9]. A similar number of studies report an age related increase in arousal problems [9,14] as report no change in arousal problems with age [10,33]. Most studies report that problems with pain during intercourse decrease with age [9,11,13,23,24], or at least remain constant [8,28]. Relatively few studies have investigated changes in vaginismus with age. One study that did investigate the proportion of women reporting vaginismus and age found no significant relationship [28].

Longitudinal Studies

The main outcomes considered in longitudinal studies that investigate the effects of age on women's sexual function are sexual interest/desire and the frequency of sexual activities. The most commonly observed pattern for sexual interest/desire among respondents in longitudinal studies is stability over time [39,40]. However, there are also reports of desire declining with age [5,40]. Studies that report patterns of stability often report patterns of increase and decline but in smaller percentages of the sample [39,40]. The frequency of sexual activities has been shown to decrease with age [5]. Longitudinal studies also show that partner factors play an important role in determining the frequency of sexual activities and desire over time [5,39,40].

Discussion

Changes in Sexual Function with Age

Cross-sectional studies provide strong evidence that sexual activities and sexual function decline with age [2,3,10,13,31,33,35,36]. It is difficult to assess accurately when this decline begins. Most studies investigating sexual function and sexual activities do not include women under the age of 35 years [3,41] and those that do include younger women use broad age categories to analyze their data [33,35]. The best estimate is that a woman's sexual function and frequency of sexual activities start to decline sometime between her late 20s and late 30s [2,33,35].

A decline in sexual activities and sexual function has also been observed in longitudinal studies [5,40]; however, a significant proportion of respondents in longitudinal studies report no change in desire with age [39,40]. There are a number of reasons why this might be the case. The ability of longitudinal studies to detect small changes that occur over longer periods of time is restricted by the length of follow-up, which is rarely much longer than 10 years. Thus, these changes may only be detectable in some women. Many studies that report patterns of stability over

time also report patterns of increase and decline in small percentages of the sample. In addition, in older cohorts a large proportion of those who show no change in sexual frequency or desire over time are women who are no longer sexually active or feel no desire [39]. However, there is further evidence that sexual activities and sexual function may be relatively resistant to change, at least over the short term. Koster and Garde (1993) [39] found that current frequency of desire was correlated with former sexual activity. More recently, Dennerstein and Lehert (2004) [12] found that prior level of sexual function was the most important predictor of current sexual function. It is reasonable to conclude that for most women sexual function and activities decline gradually with age, making these changes difficult to detect over short periods of time.

Although less common, increases in women's sexual function and activities with increasing age have been observed. Often, a small percentage of women in longitudinal studies (5–15%) report an improvement in these aspects of their sexuality with increasing age. One reason for the increase may simply be regression toward the mean. A further decline in function experienced by a woman who reports the lowest level on a scale will not be detected, and it is likely that at some point the factors contributing to her being at the lowest end of the spectrum will change. The result is an improvement in a woman's sexual function to bring it more in accordance with the majority of women her age. An increase in sexual desire, for example, has been predicted by weak desire and reports of negative marital relations [40]. In a study of women aged 46–71 years, George (1981) [42] found that 5% reported an increase in sexual activity over the 6 years of follow-up, but half of these had resumed sexual activities after a period of cessation. Interestingly, an increase in sexual function that is specific to the oldest age groups has occasionally been reported [17]. This is most likely due to a survival effect, with sick, sexually inactive women dying and so no longer being included in the cohort, or their partners dying and renewed sexual activity taking place with a new partner. For practical reasons, longitudinal studies rarely have long periods of follow-up, so these improvements are not ones that span youth to old age but more likely represent short periods of improvement in a general pattern of decline. Most studies suggest those who report increasing sexual interest are small in number and become steadily fewer with age [3].

The Impact of Relationship Factors

The availability of a regular partner has a significant influence on a woman's sexual activities as she ages. In 1953 Kinsey [30] investigated changes in sexual frequency with age and reported differences in the pattern observed in married women compared with unmarried women. Studies investigating women over the age of 60 years have shown that a substantially higher proportion of married women are still sexually active compared with women who are single, divorced, or widowed [35,43]. Feelings of desire and enjoyment of sexual activities are also affected by the availability of a partner, although studies disagree on whether this is a positive or negative relationship [18,39].

As a woman ages, so too does her partner. We would expect the age, health, and sexual function of her partner to affect the sexual activities they share. Kinsey (1953) [30] reported that the frequency of sexual activities remained constant in unmarried women up to age 55 years. In men, he found that sexual activities declined steadily from puberty onwards. Married women, however, were found to have a similar pattern of decline to men. Kinsey suggested that declining frequency of intercourse and orgasm that a woman experiences in marriage could be the result of her husband's aging rather than her own. With increasing age, there is an inevitable decline in health and increasing use of medications that may affect sexual function. The chances a woman's partner will develop a sexual dysfunction increases as they both age [44]. Fugl-Meyer and Fugl-Meyer (2002) [45] reported that women whose partners suffer from erectile dysfunction have a higher prevalence of a range of sexual problems compared with the general community. In heterosexual couples the effect of the male aging on the relationship is enhanced by the fact that on average men are older than their partners [35]. This is the most likely explanation for why the frequency of intercourse reported is higher in males than in females of the same age [35,42]. These issues may also help explain why women report lower levels of sexual interest than their male peers [17,42].

The impact of increasing age on women who have partners is confounded by the increasing length of the relationship. James (1981, 1983) [46,47] investigated changes in coital rates with the duration of marriage and reported the frequency of sexual intercourse halving in the first 12 months of a relationship then halving again over the next 20 years. In a study of Finnish women aged 18–54 years, Kontula and Haavio-

Mannila (1995) [36] found that the percentage of women who had engaged in sexual activities, including masturbation, decreased with the length of the relationship. After adjusting for age, this effect of the length of the relationship was reduced but not eliminated. There is also evidence that some aspects of sexual function may decline with increasing length of relationship. Fugl-Meyer and Fugl-Meyer (1999) [14] reported that sexual desire and interest decreased with length of relationship for women in their late teens to early 30s and sexual desire decreased with length of relationship for women in their early 50s to mid-60s. In an investigation by Hawton et al. (1994) [48] where age was held constant in the analysis, an inverse relationship was found between women's enjoyment of sexual activities and the length of the relationship.

Partner factors may be as important as a woman's own sexual function in dictating when sexual activities in the relationship end. Some early investigations reported that the majority of women blamed their husbands for ending sexual activities in the relationship and the majority of men blamed themselves [17,42,49]. More recently Blumel et al. (2004) [50] conducted a clinically based study of 534 Chilean women aged between 40 and 64 years and found that the reasons for ending sexual activities varied with age. The most common reason given for ending sexual activities was partner erectile dysfunction in women younger than 45 years, low sexual desire in women between 45 and 59 years, and lack of a partner for women older than 60 years.

While desire and the frequency of sexual activities decline with length of a relationship, the forming of a new relationship may reverse this trend, at least temporarily. In a community-based cross-sectional study of 2,001 women aged 45–55 years, 7% of respondents reported increased sexual interest compared to 12 months previously. This increase in sexual interest was most commonly associated with a new partner [41].

There are a range of other issues that have the potential to affect a woman's sexual function and activities as she ages. Sexual communication has been reported to decrease with age [44]. There is also evidence that a woman's feelings toward her partner may change with certain hormonal conditions that occur during her life such as the menopausal transition [50]. With increasing age, sexual satisfaction appears to either remain at the same level [4,11,38] or decline [1,14,15,44]. While changes in sexual satisfaction may occur in response to changes in sexual function, it is likely that a broad range of relationship issues are involved as well. Reproductive changes and the menopausal transition have major influences on a woman's sexual function and sexual dysfunction. However, these issues are beyond the scope of this review except to say that reproductive changes and different menopausal states are inherently confounded with aging.

Sexual Dysfunction and Aging

Unlike sexual function, the prevalence of sexual difficulties or dysfunctions reported by women largely do not change with age [8,10,14,23,24, 28,33,34,38], and there are even reports of these problems declining with age [8–11,13,23,24]. This is counter-intuitive since there is good evidence that sexual function declines with age, so one might expect sexual dysfunction to increase. Changes in sexually related personal distress and the importance of sex with age may hold the key. There is evidence that as women get older, the relative importance of sex may decrease [16,29]. It is less clear how sexually related personal distress changes as women age. Some aspects of sexual anxiety and distress have been investigated. Bancroft and colleagues explored distress about the relationship and one's own sexuality in a group of 987 women aged between 20 and 65 years [33]. In selected comparisons, both forms of distress increased slightly with age, but for the most part there was no significant relationship with age. Laumann et al. (1999) [10] found that anxiety about sexual performance decreased with age, and Richters et al. (2003) [9] found that while anxiety during sex remained constant with age, worrying about attractiveness decreased. Oberg et al. (2004) [51] reported that the proportion of women who felt that their sexual "disability" caused a problem in their sex life was not related to age. Only recently have validated instruments for assessing sexually related distress been developed [21]. Thus, validated measures of sexual distress have rarely been formally included in epidemiological studies. However, it is possible that the use of phrases such as "having trouble achieving" [2] or "do you have sexual problems" [38] in the questions themselves or the introduction to questions that intend to assess sexual dysfunction may mean that an element of personal distress is incorporated into the responses given by participants. If sexually related distress does decline with age, either as a result of the declining importance of sex or other factors, it may explain why the number of women

motivated to report sexual difficulties does not increase with age.

Conclusion

Given the age-related decline in sexual function, one might expect that sexual difficulties or dysfunctions would increase with age. This does not appear to be the case. The prevalence of most sexual difficulties or dysfunctions changes very little with advancing age, and sexual pain disorders appear to decline. An age-related decline in sexually related personal distress might help explain this. Certainly, the importance of sex does appear to decline with age. Data in this area are limited, and more research needs to be carried out before we have a clearer idea of the processes involved.

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