

# SWAN: A Multicenter, Multiethnic, Community- Based Cohort Study of Women and the Menopausal Transition

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## I. INTRODUCTION

Menopause is a universal phenomenon of women, yet, as discussed in other chapters in this book, it is in-

completely understood [1,2]. Furthermore, much of what is known is based on data from Caucasian women, from women who are self-referred to menopause clinics, or from convenience samples of women seen in the clinical setting

for other health problems. In the next two decades, approximately 40 million American women will experience the menopause [3] and by the year 2005, it is estimated that \$3–5 billion will be spent annually for hormone replacement therapy (HRT) and the physician monitoring of that HRT use [4]. Additionally, study of the menopause poses special methodological challenges because of its transitional nature, the potential for involving multiple organ systems (i.e., bone, lipids, mental health), and the potential contribution of varied social, behavioral, and cultural factors (see Chapter 10). Thus, study of the menopausal transition is both important and complex.

To address many of the knowledge deficits about the menopausal transition identified in chapters of this book, the Study of Women's Health Across the Nation (SWAN), a multisite, longitudinal study of the natural history of menopause, was funded by the National Institute on Aging, the National Institute of Nursing Research, and the Office of Research on Women's Health. The overall goal of SWAN is to describe the chronology of the biological and psychosocial characteristics of the menopausal transition and the effect of this transition on subsequent health and risk factors for age-related chronic diseases.

Because investigation of the menopausal experience in minority women has been neglected, SWAN placed special emphasis on including minority populations. This would allow SWAN to describe the sociocultural, lifestyle, psychological, and biological characteristics of these groups in relation to the menopausal transition [5]. In addition, emphasis was placed on recruiting a sample of women that was community or population based, rather than volunteer or clinically based, so that the sample would be representative of women from the full spectrum of socioeconomic status and cultural experiences.

The specific aims of SWAN, shown below, are being addressed in a representative cohort of initially premenopausal women who are socially and culturally diverse. The aims are as follows:

1. To characterize the symptomatology, hormonal, and bleeding pattern characteristics related to the menopausal transition.
2. To investigate the hormonal and menstrual bleeding pattern characteristics related to change in bone mineral density, cardiovascular status markers, measures of carbohydrate metabolism, and body composition during the menopausal transition.
3. To examine the relations of psychosocial factors, personality characteristics, and behaviors, including lifestyle behaviors, as they may relate to age at onset, symptoms, and physiological changes of the menopausal transition.
4. To discern what changes observed over time are related to the menopausal transition as compared to age-related changes, including those changes that appear to accelerate the aging process.

5. to describe and quantify cultural and ethnic differences among women with respect to midlife aging and the menopausal transition among the four race/ethnic groups of the cohort, in addition to non-Hispanic Caucasians.

This chapter is an overview of the SWAN study design and includes a brief description of SWAN's comprehensive data collection. The data being collected mirrors the specific aims, reflecting the belief that the biologic process of menopause occurs within the context of diverse personality characteristics, psychosocial factors, and behavioral attributes as well as an ethnic and cultural context. Consequently, the methods used to recruit this important sample of multiethnic women are described and the strengths and limitations of those methods are discussed.

## II. OVERVIEW OF THE STUDY DESIGN

SWAN is organized as a prospective, multicenter, multi-ethnic, multidisciplinary study of the natural history of the menopausal transition, under the auspices of a cooperative agreement between the National Institutes of Health and seven sites with clinical examination facilities, a data coordinating center, and two laboratories. Appendix 1 shows the locations, investigators, and roles of those investigators. SWAN includes a large and representative sample of African-American, non-Hispanic Caucasian, Chinese, Hispanic, and Japanese women. The study design, developed in a collaborative process, consists of a cross-sectional study and a longitudinal cohort study, both of which employ common protocols across the seven sites with clinical examination facilities. Focus groups were conducted to inform the development of the study design and the protocols and to ensure the relevance and the appropriateness of the protocols to the multiethnic cohort.

The SWAN Cross-sectional Study consisted of a 15- to a 20-minute telephone interview (or face-to face interview in those instances in which no telephone number could be associated with the sampled respondent). The interview was administered to 16,065 women aged 40–55 years who were randomly selected from sampling frames established at each site with clinical examination facilities (described more fully in Section IV). The two purposes of the SWAN Cross-sectional Study were to identify women eligible for study longitudinally and assess, cross-sectionally, those factors associated with the age at natural menopause, the prevalence of surgical menopause, symptoms of menopause, health status, and health care use. Additional information about the eligibility criteria, sampling frames, and characteristics of participants are discussed in Section IV.

On completion of the interview, eligibility for the longitudinal study was determined and women meeting the eligibility criteria were invited to join that cohort. The annual examinations of the SWAN Longitudinal Study include

TABLE I The Breadth of Measures and Their Frequency of Ascertainment in the SWAN Longitudinal Study

Type of measurement	Frequency <sup>a</sup>	Type of measurement	Frequency <sup>a</sup>
<b>Questionnaire</b>		<b>Specimen data<sup>b</sup></b>	
Socioeconomic status	Annual	Blood (serum)	
Medical history	Annual	E <sub>2</sub> , FSH, SHBG, DHEAS, testosterone	Annual
Psychosocial environment	Annual	TSH	Base line
Lifestyle behaviors	Annual	Glucose and insulin	Annual
Menstrual status	Annual	Fibrinogen, factor VII, PAI-1, TPA antigen	Base line
Natural/surgical menopause	Annual	Lipid profile, HDL subfractions, lipoprotein (a)	Base line, F/U-01, 02, 03, 05
Symptoms	Annual	Biochemical bone turnover markers (at five sites)	Base line, F/U-01, 02, 03
Use of medical services	Annual	Serum repository specimens	Annual
Use of medications	Annual		
Quality of life	Annual	Urine	
Sexual activity	Annual	N-Teleopeptides (at five sites)	Annual
Food frequency	Base line, F/U-04	Urine repository specimens	Annual
<b>Clinic measurements</b>		<b>Other data collection beyond annual evaluation</b>	
Anthropometry	Annual	Abstract medical records for hysterectomy	Monthly
Blood pressure	Annual	Menstrual calendars	
Bone density (at five sites)	Annual	Daily Hormone Study (subsample of 900)	One cycle, annually

<sup>a</sup>Note: F/U denotes a follow-up examination; the number denotes which follow-up examination.

<sup>b</sup>Abbreviations: E<sub>2</sub>, estradiol; FSH, follicle-stimulating hormone; SHBG, sex hormone binding globulin; DHEAS, dehydroepiandrosterone sulfate; TSH, thyroid-stimulating hormone; PAI-1, plasminogen activator inhibitor-1; TPA, tissue plasminogen activator; HDL, high-density lipoprotein.

questionnaires, blood and urine specimen collection, and physical measures (Table I).

Because the SWAN Longitudinal Study is focused on the menopausal transition, unique data collection activities are required. For example, the annual examinations are scheduled for days 2–5 after bleeding commences to standardize serum hormone measures to the early phase of the menstrual cycle. In addition, the cohort is followed with monthly menstrual cycle calendars and a subset of the cohort participates in daily urine collection as well as maintaining a daily symptom diary for one complete menstrual cycle on an annual basis. The following section describes the data collection more fully.

### III. DATA COLLECTION

#### A. Theoretical Approaches

As a multidisciplinary study, the SWAN data collection instruments and approaches were developed to address the potential contribution of the multiple theories surrounding the study of the menopausal transition [6]. For example, the *biological approach* ascribes the experience of the menopause particularly within the framework of alterations in metabolism and endocrine status. The *psychological/psychosocial approach* maintains the importance of stressors and losses as catalysts for symptoms. The *sociocultural/environmental approach* indicates that cultural constructs and lifestyle factors define our responses toward the menopause and the presentation of potential symptoms. Finally, the *feminist*

*theory* views the menopause as a normal developmental stage with its own unique challenges. The instruments and data collection activities of SWAN have reflected an inclusive approach that acknowledges the need for and value of each of these perspectives, while minimizing the reductionist approach to studying and interpreting the characteristics of the menopause transition.

#### B. Types of Data

The types of data collected from SWAN participants in the annual examinations are shown below in examples that include the type of construct and contributing variables.

Construct	Variable
Acculturation	Language used, cultural and religious practices, dietary practices
Body size history	Weight changes associated with each pregnancy, weight cycling
Contraception	Use of contraceptive methodologies
Hormone use practices	Use of hormone preparations, past use of oral contraceptives, and current contraception methodology
Lifestyle behaviors	Smoking history and current passive smoke exposure; current caffeine and alcohol consumption; diet and dietary practices, including use of supplements; amount and frequency of physical activity practices, including planned exercise

Construct	Variable
Menstrual status	Current menstrual bleeding characteristics and their variation according to timing, duration, and intensity; usual premenstrual symptoms, if any
Psychological status	Depression, hostility, and stress
Recent medical care utilization	Frequency of prevention behaviors, including Pap smear, physical breast exam, and physician visit for health problem or routine check-up; use of complementary and alternative health approaches; health insurance
Relationships	Number, nature, and satisfaction with relationships; life satisfaction
Reproductive history	Age at menarche, gravidity, parity, pregnancy losses, infertility, lactation practices
Self-perception	Quality of life, health status, degree of physical activity
Sexuality	Types of practices, satisfaction, and attitudes toward sex
Significant life events	Marriage, divorce, death or birth in family, change in or loss of job, illness, social support, occupational stress (autonomy)
Significant medical history	Diagnosis by a physician of hypertension, cardiovascular disease, malignancies, or thyroid disease; fractures, pelvic surgery, urinary incontinence, current medications, family history of health events
Sociodemographic status	Age, birth date, birthplace, marital status, level of education, income of household, occupation and the physicality of one's work, household composition
Social environment	Discrimination, religiosity, and spirituality

The interview data will be linked with other information being collected annually that describes the physical and hormone status of enrollees. The general areas of interest and the variables that contribute to the constructs are shown below.

Construct	Variable
Blood pressure	Resting systolic and diastolic blood pressure, resting heart rate
Body composition and body topology	Weight, height, waist and hip circumference, body composition (the latter from five sites with bone densitometry facilities)

Construct	Variable
Bone status and its turnover	Bone mineral density of the femoral head, lumbar spine, and total body (from five sites with bone densitometry facilities); biochemical measures of bone formation and resorption
Carbohydrate and energy metabolism	Glucose, insulin and thyroid-stimulating hormone concentrations (the latter at base line)
Clotting factors	Fibrinogen, factor VIIc, plasminogen activator inhibitor-1, tissue plasminogen activator antigen
Lipid metabolism	Total cholesterol, triglycerides, high- and low-density lipoprotein cholesterol, high-density lipoprotein cholesterol subfractions, lipoprotein (a)
Reproductive hormones	Estradiol, follicle-stimulating hormone, sex hormone binding globulin, progesterone, and testosterone

Two additional data collection elements, monthly menstrual cycle calendars and daily specimen/diary collection, are important in more precisely characterizing the transitional process. The monthly menstrual calendars provide a record of the changing characteristics of menstrual bleeding from month to month. These monthly calendars also include a record of the use of oral contraceptives or other hormones, symptoms, and the occurrence of any gynecological surgery or procedures. A more extensive calendar is in use at three clinical sites to ascertain lifestyle factors including dieting, shift work, exercise practice, and smoking behavior, as well as stress.

A Daily Hormone Study (DHS) contributes to the SWAN specific aims by providing a more complete understanding of the variation in hormone concentrations throughout menstrual cycles (or equivalent time periods) of the perimenopausal transition and characterizing changes in the nature and frequency of within-cycle events, such as ovulation. Blood and urine specimens are being collected from a subsample of 900 women, with participation at each of the seven sites and from each of the race/ethnic groups as well as the non-Hispanic Caucasian women. Participants collect daily urine specimens for one complete menstrual cycle each year. These urine specimens are assayed for excretion products of the pituitary (the gonadotropins, luteinizing hormone, and follicle-stimulating hormone) and the ovary (estrone conjugate and pregnanediol glucuronide). The goal is to describe the changes in the hormone concentrations at important points during the menopausal transition and prior to the final menstrual period. The DHS also includes a daily diary to characterize symptoms and social dimensions of each day during the cycle of the daily urine collection.

TABLE II The Site-Specific Recruiting Goals for Race/Ethnicity Percentage in the SWAN Longitudinal Study of the Menopausal Transition in Seven Geographic Locales<sup>a</sup>

Geographic locale	Primary race/ethnic self-identification (%)				
	African-American	Chinese	Hispanic	Japanese	Caucasian
Detroit, Michigan (Ypsilanti/Inkster)	66				33
Chicago, Illinois (Morgan Park/Beverly)	55				45
Boston/Cambridge, Massachusetts	45				55
Pittsburgh, Pennsylvania (Allegheny County)	33				66
Oakland, California (plus Hayward and Richmond)		55			45
Newark, New Jersey (Hudson County)			66		33
Los Angeles, California (South Bay/Sawtelle)				55	45

<sup>a</sup>Each site was to recruit at least 450 women to the SWAN Longitudinal Study with the proportion of primary race/ethnicity among women described in the table.

Collectively, the monthly menstrual calendars and the Daily Hormone Study help to refine the definition of the menopause by providing more frequent and supplemental data during the transitional period. It is anticipated that an outgrowth will be the provision of more comprehensive understanding of the bleeding and hormone markers of the onset of perimenopause and the stages within the transition process.

#### IV. SAMPLING AND RECRUITMENT

##### A. Overview

The SWAN sampling and recruiting was implemented in seven locations in the United States: Boston, Chicago, the Detroit area, Los Angeles, Newark, Pittsburgh, and Oakland, California. The recruitment goal for each of the seven sites was to obtain representative samples of at least 450 women [non-Hispanic Caucasian women and one designated minority group (African-American, Chinese, Hispanic, and Japanese)] in a proportion specific for each site (see Table II). To achieve this goal, each site developed a sampling and

recruitment strategy that they considered optimal for the Study's scientific questions, the characteristics of the local site (including access to clinical facilities), and the specific minority population to be evaluated. The result was the use of multiple sampling frames and multiple sampling approaches implemented in a coordinated manner. SWAN thus also provides the opportunity to describe and evaluate the various sampling frames, the sampling approaches to recruiting women from those frames, and the relative impact of using the various sampling frames and approaches.

##### B. SWAN Recruitment

As indicated previously, recruitment for SWAN was undertaken as a two-step process (Table III). The first recruitment step involved a cross-sectional study to act as a sampling frame for the SWAN Longitudinal Study. The second recruitment step was the development of a longitudinal study cohort from among the SWAN Cross-sectional Study enrollees. To be eligible for participation in SWAN Cross-sectional Study, women had to meet the following criteria:

TABLE III Summary of Sampling Units Contacted to Determine Eligibility in the Two-Step Process to Identify SWAN Longitudinal Study Enrollees

Recruitment step	Sampling units	No. eligible	No. recruited	Response rate (%)
Cross-sectional study recruitment, sampling units contacted	202,985	34,985	16,065	46.6
Longitudinal study recruitment, units from the cross-sectional study	16,065	6,521 <sup>a</sup>	3,306	50.7

<sup>a</sup>There were 36 Caucasian women included in this table who were "filtered out" (i.e., eligible to enter the cohort, but not recruited because target recruitment had been met).

1. Primary residence in designated geographic area
2. Ability to speak English or designated other language—Spanish, Cantonese, or Japanese
3. Age 40–55 years at time of contact
4. Cognitive ability to provide verbal informed consent
5. Membership in a specific site's targeted ethnic groups

To identify women eligible for the cross-sectional study, sites screened the constituent sampling units from the sampling frames. Depending on the site, the sampling units were the households, telephone numbers, or individual names of women; the sampling frames were the listings of the sampling units. Study-wide, 202,485 sampling units from sampling frames were evaluated, leading to the identification of 34,446 eligible women. Of these, 16,065 women completed the SWAN Cross-sectional Study.

The eligibility criteria for the SWAN Longitudinal Study were as follows:

1. Aged 42–52 years
2. No surgical removal of the uterus and/or both ovaries
3. Not currently using exogenous hormone preparations affecting ovarian function
4. At least one menstrual period in the previous 3 months
5. Self-identification with one of each site's designated race/ethnic group

From the SWAN Cross-sectional Study, 6557 women were identified as eligible for longitudinal study. Of these women, 36 Caucasian women were "filtered out," i.e., they were not asked to participate in the longitudinal study because the site had met its target sample size. Of the remaining 6521 women, 3306 were recruited for the SWAN Longitudinal Study (see Table IV). This is the cohort currently being followed.

### C. The Sampling Frames

To identify the cohort for the longitudinal study, sites had to address successfully three competing requirements. These requirements were to (1) identify populations representative of a defined and diverse community, (2) recruit women from a specified race/ethnic minority group in a proportion significantly greater than the groups' proportion in the general United States population, and (3) implement the recruitment in a defined and circumscribed geographic locale so that relatively intense longitudinal clinical studies could be sustained. To meet these requirements and to be cost-efficient, the seven sites selected study communities that had a relatively higher density of the particular racial/ethnic minority group designated for recruitment. Then, individual sites utilized a variety of sampling frames from which the sample(s) would be drawn. In general, these sampling frames included telephone numbers randomly generated from random digit dialing (RDD)-based and list-based frames (Table IV). The following sections describe both types of frames in the context of the SWAN geographic locations and racial/ethnic group requirements. Appendices 2 and 3 provide specific information about the sampling approach at each clinical site.

#### 1. RANDOM DIGIT DIALING-BASED FRAMES

The sampling unit for RDD frames was a telephone number and the only eligibility information available from an RDD frame consisted of the telephone number itself, i.e., the geographic location associated with the telephone number's exchange. Three sites [Newark area, Pittsburgh area, and Los Angeles (Table IV)] use an RDD-based sampling frame as the major frame. Two of these sites (Newark and Los Angeles) used list-assisted RDD-based sampling, and the Pitts-

TABLE IV The Primary Sampling Frame, Supplemental Frames, and Type of Supplemental Information Provided to the Primary Frame According to Geographic Locales

Geographic locale	Primary frame type <sup>a</sup>	Primary frame <sup>b</sup>	Supplemental frames <sup>c</sup>	Supplemental information added to frames
Boston	List	City census listing	None	Telephone numbers, face-to-face contact
Chicago	List	Enrollment list from earlier study	None	None
Detroit	List	Electrical utility company customer listing for community census	None	Telephone directory, race from organization lists and VRL, face-to-face contact
Oakland	List	HMO enrollment list	None	None
Los Angeles	RDD	RDD 3+ approach	VRL, telephone directory list, ethnic organization membership lists, snowball	—
Pittsburgh	RDD	RDD	VRL	Telephone directory
Newark	RDD	RDD 3+ approach	Snowball	None

<sup>a</sup>RDD, Random digit dialing.

<sup>b</sup>3+ is a variation in random digit dialing that increases the likelihood that telephone numbers are households and not commercial firms.

<sup>c</sup>VRL, Voter registration list.

burgh site used voter registration lists as their important secondary frame. Sites with a primary RDD sampling frame implemented the following steps:

1. Each telephone number was screened to determine if it represented a household.
2. The household was then screened to verify that the household was in the target geographic area and to determine if any woman age-eligible for the cross-sectional study was in residence.
3. Personnel then determined whether the household included at least one age-eligible woman who was Caucasian or was from the site's designated racial/ethnic minority group.

All three of the sites that used the RDD sampling frame supplemented the RDD frame with list-based or "snowball" (referral by other participants) sampling frames.

## 2. LIST-BASED FRAMES

At four sites, lists representing households (Detroit area) or individual women (Boston, Chicago, and Oakland areas) comprised the primary sampling frames. The list-based frames were varied and included a state-mandated census in Boston, an electrical utility customer listing in the Detroit area, a census from a previous study in the Chicago area, and a health maintenance organization (HMO) enrollment list in the Oakland, California area. Although each of these sites recruited its entire sample using a list sampling frame, only one site had a single frame that included all the information necessary to determine eligibility *a priori* (age, address, telephone, geographic area, race/ethnicity, gender) for recruiting to the SWAN Cross-sectional Study. That single list-based frame had been developed in a previous research study.

## D. Sampling Strategies

Specific sampling procedures varied across sites and were a function of the sampling frame(s) used and the level of information available with the frame(s). Sampling procedures included conducting a census, implementing an area probability sampling, and identifying acquaintance networks with snowballing. For example, the Detroit site conducted a census in which every household in the selected geographic area was enumerated and contacted, with the probability of selection being 1. Area probability samples were developed and implemented in the Chicago, Oakland, and Pittsburgh areas, where women were sampled with a known probability of selection that was  $<1$ . In addition to using their RDD samples, the sites at Los Angeles and Newark also used snowball sampling. With snowball procedures, selection probabilities could not be determined.

To minimize the likelihood of selection bias from factors such as seasonal variation or systematic sampling, sites

organized their contacts with the sampling units into "batches." Each batch was a random sample within the overall sample from the particular site. The approximate size of each batch was derived from the number of sampling units that the site projected could be contacted in a 2-month time period.

For those households with more than one eligible woman, a single eligible woman was sampled by one of two approaches. Five sites sampled by selecting the woman in the household with the most recent birthday (month and day only), an approach referred to as the "birthday" method. Two sites (Los Angeles and New Jersey) sampled the first woman contacted who was willing to provide information. Only one household member was sampled to avoid clustering of women within households for study variables such as health status and health care use.

All sites used computer-assisted telephone interviewing (CATI) with standardized interviews and scripts to facilitate contact in a consistent manner, thereby minimizing the opportunity for information bias. When telephone numbers were unavailable for a sizable proportion of the population, as was the case for the Detroit area census, interviewers directly contacted those households without listed telephone numbers, face to face.

## E. Computation of the Response Rates

Common disposition codes were used to define the status of each sampling unit eligible for contact and to facilitate the computation of the response rates (see Table V). Response rates for the SWAN Cross-sectional Study were calculated as follows:

TABLE V Disposition Codes for Units of Telephone Numbers, Households, or Individual Women in SWAN

1.	Unusable sampling unit (i.e., business or fax telephone number, deceased woman)
2.	No contact, unknown usability (i.e., busy signals, answering machine, never home, moved and cannot be traced)
3.	Contact made, unknown cross-sectional eligibility (i.e., hang-up, refusal to be screened for the cross-sectional screening interview)
4.	Contact made, ineligible for the cross-sectional interview
5.	Contact made, cross-sectional eligible, unknown cohort eligibility (incomplete cross-sectional screening interview)
6.	Completed cross-sectional screening interview; cohort ineligible or cohort eligible and an attempt was made to recruit into the cohort
7.	Completed cross-sectional screening interview; cohort eligible but no attempt was made to recruit into the cohort (i.e., "filtered" at the point of cohort recruitment because of adequate recruitment)
8.	Cross-sectional eligible but no attempt was made to recruit for cross-sectional interview (i.e., "filtered" at point of cross-sectional interview)

1. The proportion of eligible women was calculated among women with known eligibility (disposition codes 4 through 8):  $p_e = (5 + 6 + 7 + 8)/(4 + 5 + 6 + 7 + 8)$ .

2. This proportion then was applied to the total number of sampling units with unknown eligibility (disposition codes 2 and 3), to estimate the potential number of eligible women among those with unknown eligibility (assuming it was the same as those with known eligibility):  $p_e (2 + 3) = E_u$ .

3. The total number of women whom sites attempted to recruit for the Cross-sectional Study was computed as the sum of known eligible women recruited ( $5 + 6 + 7$ ) and the estimated potential number of women among those with unknown eligibility ( $E_u$ ):  $(5 + 6 + 7) + E_u = R$ .

4. The participation rate was estimated as the number of women participating in and completing the interview divided by the estimated total number of eligible women whom the site attempted to recruit:  $(6 + 7)/R$ .

Women known to be eligible but not asked to participate in the cross-sectional interview [because a sufficient number had been recruited (disposition 8)] are included in the calculation of percentage eligible. They were excluded from the calculation of the cross-sectional participation rate because they were not actually recruited to complete the cross-sectional study.

Table VI gives the distribution of sampling units for the SWAN Cross-sectional Study disposition codes by site and indicates the greater efficiency from those frames containing more eligibility criteria information. The percentage of unusable units sampled (disposition code 1) was lower for list-based sites (0–14%) as compared with the sites using primarily RDD-based sampling (19–35%). Sites primarily using a list-based frame also had a lower (<11%) percentage of sampled units with no contact due to busy signals, answering machines, never being home or moved and inability to trace (disposition code 2) as compared with the RDD-

based sampling (11–25%). The two list-based sites whose frames had substantial eligibility and recruiting information (an HMO enrollment list and a list from a previous research study) required the fewest number of sampling units (<3500) to reach their cohort targets. In contrast, those sites whose frames did not include information about the eligibility criteria information sampled 24,283 to 78,914 sampling units to meet their specific cohort targets.

The percentage of sampled units with contact made but unknown cross-sectional eligibility (i.e., hang-ups and disposition code 3) varied widely across sites, but was not related to RDD-based versus list-based frame status. The percentage of known ineligible units (disposition code 4) did not differ greatly across sites, with the exception of the Detroit area, where the investigators were conducting a census of all households and were not allowed into three apartment dwellings. The percentage of eligible women who began but did not complete an interview (disposition code 5) was uniformly low across all sites (less than 3%).

## F. Response Rates

A total of 202,985 sampling units were screened for potential participation in the SWAN Cross-sectional Study. Of these, 34,985 were defined as eligible and 16,065 completed the interview, for an overall response rate of 46.6%. Of these, 6521 women were cohort-eligible and were asked to participate in the SWAN Longitudinal Study; a total of 3306 women entered the cohort, for an overall response rate of 50.7% (Table III).

Response rates did not vary statistically by age, marital status, parity, or menopausal status (see Table VII) whether considering the overall group or just non-Hispanic Caucasian women. However, women with a high school education or less (response rates of 37.3 and 40.8%, respectively) were

TABLE VI The Number and Percentage of Sampling Units Used in the SWAN Cross-Sectional Study by Site and Common Disposition Codes

Disposition code	Number (percentage) per site <sup>a</sup>							
	Boston (L)	Chicago (L)	Detroit (L)	Los Angeles (R)	Newark (R)	Pittsburgh (R)	Oakland (L)	Total across sites
1	2517 (13.6)	26 (1.1)	1006 (4.1)	10,804 (24.8)	15,504 (19.6)	11,239 (35.3)	8 (0.2)	41,100 (20.2)
2	9524 (51.3)	43 (1.8)	2587 (10.6)	7909 (18.1)	19,636 (24.9)	3540 (11.1)	308 (9.3)	43,547 (21.4)
3	1188 (6.4)	203 (8.3)	2504 (10.3)	4749 (10.9)	21,249 (26.9)	1552 (4.9)	434 (13.1)	31,879 (15.7)
4	2778 (15.0)	742 (30.3)	14,937 (61.5)	17,360 (39.8)	18,774 (23.8)	12,027 (37.8)	1025 (30.9)	67,643 (33.3)
5	328 (1.8)	43 (1.8)	662 (2.7)	104 (0.2)	261 (0.3)	596 (1.9)	25 (0.8)	2019 (1.0)
6	2233 (12.0)	1393 (56.8)	2551 (10.5)	2242 (5.1)	3490 (4.4)	2604 (8.2)	1516 (45.7)	16,029 (7.9)
7	0 (0.0)	0 (0.0)	36 (0.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	36 (0.02)
8	0 (0.0)	0 (0.0)	0 (0.0)	446 (1.0)	0 (0.0)	278 (0.9)	4 (0.1)	728 (0.4)
Site total	18,568	2450	24,283	43,614	78,914	31,836	3320	202,985

<sup>a</sup>L, List based; R, RDD based. Numbers in parentheses are percentages.

TABLE VII Longitudinal Cohort Percentage Participation among Cohort-Eligible Women<sup>a</sup>

Subject characteristic	Overall sample participating in cohort (%)	Caucasians participating in cohort (%)
Overall	50.1 (48.9–51.4)	48.0 (46.2–49.7)
Age (years)		
42–45	49.4 (47.7–51.1)	47.3 (44.9–49.8)
46–49	51.9 (49.9–53.8)	49.5 (46.7–52.4)
50–52	47.4 (43.7–51.1)	45.1 (39.8–50.4)
Education		
Less than high school	<b>40.8 (36.8–44.9)</b>	<b>24.7 (15.9–33.5)</b>
High school degree	<b>37.3 (34.9–39.7)</b>	<b>29.7 (26.4–33.0)</b>
Some college	52.4 (50.2–54.6)	51.0 (47.7–54.2)
College degree	56.1 (53.2–59.0)	52.5 (48.6–56.4)
Postcollege	62.1 (59.3–64.9)	60.8 (57.4–64.2)
Smoking		
Never smoked	51.6 (49.9–53.2)	49.8 (47.3–52.3)
Past smoking	52.2 (49.8–54.8)	51.7 (48.5–54.9)
Current smoking	<b>42.3 (39.6–45.0)</b>	<b>38.1 (34.3–41.9)</b>
Difficulty in paying for basics		
Very hard	<b>42.5 (38.9–46.2)</b>	38.6 (32.2–45.0)
Somewhat hard	47.0 (44.8–49.1)	44.2 (41.0–47.5)
Not hard at all	<b>53.5 (51.9–55.2)</b>	<b>50.6 (48.4–52.8)</b>
Marital status		
Never married	50.1 (46.8–53.4)	47.3 (42.3–52.3)
Married/living as married	51.0 (49.5–52.5)	48.7 (46.6–50.8)
Separated/widowed/divorced	47.7 (45.1–50.3)	45.6 (41.5–49.8)
Parity		
1+ children	49.8 (48.4–51.1)	47.1 (45.2–49.1)
No children	52.0 (49.0–55.0)	<b>50.6 (46.9–54.2)</b>
Race/ethnicity		
African-American	54.2 (51.9–56.6)	—
Caucasian	48.0 (46.2–49.7)	—
Chinese	69.2 (64.4–73.9)	—
Hispanic	<b>34.1 (30.8–37.5)</b>	—
Japanese	63.1 (58.6–67.6)	—
Site		
Boston	48.9 (45.7–52.2)	54.9 (50.2–59.6)
Chicago	73.7 (70.1–77.2)	76.5 (71.4–81.6)
Detroit	58.9 (55.7–62.1)	59.7 (54.7–64.8)
Los Angeles	53.1 (49.9–56.3)	44.1 (39.6–48.5)
Newark	29.6 (27.2–32.1)	23.4 (19.9–26.9)
Oakland	67.3 (63.8–70.8)	65.2 (60.0–70.4)
Pittsburgh	42.8 (39.8–45.7)	41.4 (37.8–45.0)
Self-reported health		
Excellent	52.5 (49.8–55.2)	50.8 (47.5–54.1)
Very good	52.9 (50.9–55.0)	48.5 (45.8–51.2)
Good	48.8 (46.5–51.0)	45.4 (41.8–48.9)
Fair	44.1 (40.7–47.5)	43.6 (36.5–50.7)
Poor	40.5 (32.7–48.3)	38.1 (23.2–53.0)
Menopause status		
Premenopausal	49.4 (47.7–51.0)	47.4 (45.0–49.8)
Early perimenopausal	51.1 (49.3–52.9)	48.5 (45.9–51.0)

<sup>a</sup>Percentages are  $\pm 95\%$  CI. Participation is according to sociodemographic and lifestyle characteristics in the full sample ( $n = 6445$ ) and restricted to Caucasians only ( $n = 3170$ ). The 95% confidence intervals allow the comparison of frequency within each sociodemographic or lifestyle variable; statistically significant differences are shown in bold.

less likely to participate than women with some college education (response rate of 52.4%). Women with a postcollege educational experience were the most likely to participate and had a response rate of 62.1%. Likewise, those women who reported that it was somewhat hard or very hard to pay for basics (i.e., food, shelter and health care) were less likely to participate. Their response rates were 47.0 and 42.5%, respectively, as compared to the response rate of 53.5% for women who reported no difficulty in paying for basics. As reported in Table VII, women who currently smoked were significantly less likely to participate than women who had never smoked or who had quit smoking.

Participation varied according to self-reported race/ethnicity status, with Chinese (69.2%) and Japanese (63.1%) being the most likely to participate followed by African-American (54.2%), non-Hispanic Caucasian (48.0%), and Hispanic women (34.1%). Because Chinese, Japanese, and Hispanic women were recruited at single sites, the degree of participation might be representative of other site characteristics rather than race or ethnicity.

The site differences in response rates, ranging from 29.6% at Newark to 73.7% in Chicago, were believed to reflect, in part, differences in site recruitment strategies. Therefore, we evaluated response rates based on whether the site's recruitment was primarily a list-based or an RDD-based approach (see Table VIII). The response rate for sites whose primary frames were list based was 60.7% compared with a 40.3% response rate for RDD sites. Table VIII shows that although sites that relied primarily on the RDD-based approach had lower percentage participation as compared to participation at list-based sites, similar characteristics were likely to be associated with nonparticipation. Irrespective of recruitment strategy, women with less education and women who smoked or had difficulty in paying for basics were less likely to participate. Importantly for this study, response rates according to menopause status did not vary by recruitment strategy.

## V. STRENGTHS AND LIMITATIONS OF SWAN

SWAN has successfully recruited and enrolled a large community-based sample of women with substantial representation from five racial/ethnic groups. To do so, SWAN incorporated a wide range of sampling frames and diverse sampling approaches, including the extensive use of list-based frames and supplemental frames or supplemental information to the primary frames. Theoretically, it would have been desirable to select participants as a national probability sample so that the study findings could be generalized to the national population of midlife women, similar to the National Health and Nutrition Examination Surveys (NHANES) [7]. However, the demands of efficiently implementing a longitudinal study that requires intensive and ongoing (annual and

TABLE VIII Longitudinal Cohort Percentage Participation According to Sociodemographic and Lifestyle Characteristics<sup>a</sup>

Subject Characteristics	At list-based sites	At RDD-based sites
Overall	60.7 (59.0–62.4)	40.3 (38.7–42.0)
Age (years)		
42–45	59.9 (57.4–62.3)	40.1 (37.8–42.4)
46–48	63.4 (60.7–66.1)	41.0 (38.3–43.7)
50–52	55.3 (50.2–60.5)	39.1 (33.9–44.3)
Education		
Less than high school	<b>48.7 (41.8–55.7)</b>	36.6 (31.7–41.5)
High school degree	<b>44.8 (41.0–48.6)</b>	<b>31.5 (28.4–34.6)</b>
Some college	62.8 (59.7–65.9)	42.7 (39.7–45.8)
College degree	69.0 (65.1–72.8)	43.5 (39.5–47.6)
Postcollege	71.6 (68.1–75.0)	49.6 (45.2–54.0)
Smoking		
Never smoked	63.3 (60.9–65.7)	42.2 (39.9–44.4)
Past smoking	63.1 (59.6–66.5)	41.6 (38.1–45.1)
Current smoking	51.8 (47.9–55.7)	33.3 (29.7–36.8)
Difficulty in paying for basics		
Very hard	58.5 (52.6–64.4)	32.4 (27.9–36.8)
Somewhat hard	56.5 (53.3–59.6)	38.8 (35.9–41.6)
Not hard at all	<b>63.5 (61.3–65.7)</b>	43.3 (41.0–45.6)
Marital status		
Never married	57.2 (53.0–61.4)	38.5 (33.2–43.7)
Married/living as married	63.4 (61.2–65.6)	41.4 (39.4–43.4)
Separated/widowed/divorced	56.9 (53.3–60.6)	37.5 (33.8–41.2)
Parity		
1+ children	60.4 (58.5–62.3)	40.0 (38.3–41.9)
No children	62.1 (58.0–66.2)	41.5 (37.2–45.8)
Race/ethnicity		
African-American	<b>56.4 (53.8–59.1)</b>	45.7 (40.4–50.9)
Caucasian	62.7 (60.2–65.2)	36.4 (34.1–38.6)
Chinese	69.2 (64.4–73.9)	—
Hispanic	—	34.1 (30.8–37.5)
Japanese	—	<b>63.1 (58.6–67.6)</b>
Self-reported health		
Excellent	64.7 (61.0–68.4)	41.1 (37.4–44.8)
Very good	65.4 (62.5–68.3)	41.9 (39.1–44.7)
Good	56.3 (53.1–59.4)	41.4 (38.3–44.5)
Fair	55.6 (50.7–60.5)	33.6 (29.1–38.0)
Poor	46.4 (34.5–58.2)	35.7 (25.4–46.0)
Menopause status		
Premenopausal	61.4 (59.0–63.8)	39.3 (37.1–41.5)
Early perimenopausal	60.0 (57.5–62.4)	41.8 (39.2–44.3)

<sup>a</sup>Percentages are  $\pm 95\%$  CI. Data are from cohort-eligible women with sites categorized as using list-based sampling ( $n = 3099$ ) or using RDD-based sampling ( $n = 3346$ ). RDD-based sites were Los Angeles, Newark, and Pittsburgh locales; list-based sites were Boston, Chicago, Detroit, and Oakland locales. The 95% confidence intervals allow the comparison of frequency within each sociodemographic or lifestyle variable, with statistically significant differences shown in bold.

monthly) clinical data collection could not be met with a national probability sample.

Typically, exclusive reliance on list-based frames has been viewed with caution by survey researchers because of concerns about inadequate coverage (and attendant nonrepresentativeness) or the inadequacy of information related to eligibility (and attendant inefficiency). However, in SWAN, the response rate was higher at those sites using lists as their primary sampling frame and the response characteristics (i.e., education level, menopause status) were similar for both list-based and RDD-based sites. Potentially, this is attributable to the combining of several lists prior to sample selection or the use of multiple lists to provide supplemental information to facilitate recruitment after samples were selected. Nonetheless, the response rates suggest that bias from inadequate coverage by list-based frames was no different than the bias that might have resulted from the RDD-based frames.

SWAN identified supplemental approaches to use with random digit dialing sampling in small geographic areas because the technique is less efficient in small areas than in large areas [8]. These supplemental approaches helped overcome the widely recognized disadvantages of telephone sampling frames, i.e., approximately 8% of the population in the United States does not have current telephone service, and this rate varies widely depending on the socioeconomic status [9,10]. The degree to which using list-based RDD ameliorated this issue is unknown; however, future studies may need to add four to six lists and use list-assisted RDD.

These SWAN recruiting efforts demonstrate the need to have a carefully considered sampling strategy that incorporates flexible approaches and numerous frames. No methodology is clearly right or wrong; nonetheless, it is obvious that frames with the most information related to eligibility criteria were the most efficient. This study adds to our understanding of the complexities of sampling and the need for multiple methods of recruiting to identify information applicable to a broadly diverse population.

The importance of SWAN's recruitment strategies can be most appreciated within the context of ethnicity and culture. Almost no studies have simultaneously and comparatively investigated the prevalence of menopausal symptoms in multi-ethnic/multicultural populations, although there are reported cultural/ethnic differences in symptoms, age at menopause, and bleeding characteristics [11]. It is unclear if these differences (if there are true differences) are due to hormonal differences (i.e., lower serum estradiol and testosterone levels) or other physiological differences (i.e., differences in immune responses). The differences could readily be associated with cultural perceptions of the menopause and aging, dietary practices, physical activity, body composition (more fat mass or less lean mass), or reproductive practices reflected in parity or age at first conception. Furthermore, the

role of culture and acculturation (the process of incorporating the customs, norms, identification, and social and working activities from different societies in shaping health status, health belief, and health behaviors) has not been widely applied to the menopausal transition.

SWAN has also incorporated data-gathering approaches consistent with major theories and approaches to the menopause [6]. Thus, the *biological theory* ascribes the experience of the menopause to alterations in metabolism and endocrine status. Typically, with this theory, there is a pronounced focus on ovarian function and, in some, attendant focus on hormone replacement or alternative hormone sources. The *psychological/psychosocial* approach considers the importance of stressors and losses, particularly as catalysts for symptoms. The approach then suggests the need for social supports, well-developed relationships, and coping skills for a "successful" transition. The *sociocultural/environmental* approach suggests that culture frames our behaviors and attitudes toward the menopause. The external environment (i.e., passive smoking, occupational exposures, or workplace demands) modifies our biological assets and, in doing so, frames our responsiveness to the transitional events. Finally, *feminist theory*, with its views that the menopause is a normal developmental stage, urges an understanding of how women achieve control of the experience and become active participants, addressing the challenges of symptoms. The information-gathering activities of SWAN have reflected an inclusive approach that acknowledges the value of each of these to a complex process.

## VI. SUMMARY

The of SWAN study employs a prospective design that includes sufficient pre- and postmenopausal observations to ensure the separation of menopause-related and age-related physiological changes. Other attributes include the comprehensive standardized data collection related to biological, behavioral, physiological, social, environmental, and cultural factors; specialized data collection methodologies suitable to address the monthly and yearly variation in behavioral and biological patterns; generalizability to community-dwelling populations recruited from major United States population centers; sufficiently large sample sizes and numbers of data points to ensure reliable estimates of associations and relevant effect sizes; and inclusion of sufficient numbers of racial/ethnic minorities to provide comparative information with the non-Hispanic Caucasian population. Because of these attributes, SWAN can contribute new and substantive knowledge about women's health in general and the menopause transition in particular. SWAN is the first national study to describe women at midlife, an understudied age group. Its multidisciplinary approach provides the opportu-

nity to consider the contributions of both culture and biology so that we may better understand health in American women.

## APPENDIX A. SWAN INVESTIGATORS

### Clinical Sites

#### Boston

Principal Investigator: Robert Neer, M.D.  
 Coprincipal Investigator: Joel Finkelstein, M.D.  
 Coinvestigators: Josh Alexander, Ph.D.; Andrew Arnold, M.D.; David MacLaughlin, Ph.D.; Richard Pasternak, M.D.  
 Biostatistician: David Schoenfeld, Ph.D.  
 Project Manager: Tracy Thomas, B.A.

#### Chicago

Principal Investigator: Lynda Powell, Ph.D.  
 Coprincipal Investigator: Denis Evans, M.D.  
 Biostatistician: Peter Meyer, Ph.D.  
 Project Manager: Diedre Wesley  
 Data Manager: Gerard Kaszubowski

#### Detroit

Principal Investigator: MaryFran Sowers, Ph.D.  
 Coprincipal Investigators: Sioban Harlow, Ph.D.; John Randolph, M.D.  
 Coinvestigators: Carolyn Sampsel, Ph.D.; Nancy Reame, Ph.D.  
 Biostatisticians: Roderick Little, Ph.D.; M. Anthony Schork, Ph.D.  
 Project Manager: Vanessa Harris, M.P.H.  
 Data Managers: Ruth Sanchez-Pena, M.S.; Gavin Welch, M.P.H.

#### Los Angeles

Principal Investigator: Gail Greendale, M.D.  
 Coprincipal Investigator: Stanley Korneman, M.D.  
 Project Manager: Miriam Schocken, Ph.D.

#### Newark

Principal Investigator: Gerson Weiss, M.D.  
 Coprincipal Investigator: Nanette Santoro, M.D.  
 Biostatistician: Joan Skurnick, Ph.D.  
 Project Manager: Ann Reinert  
 Data Manager: Pat McTerrell

#### Oakland

Principal Investigator: Ellen Gold, Ph.D.  
 Coprincipal Investigator: Barbara Sternfeld, Ph.D.  
 Coinvestigators: Barbara Abrams, Ph.D.; Shelley Adler, Ph.D.; Gladys Block, Ph.D.; Maradee Davis, Ph.D.; Bruce Ettinger, M.D.; William Lasley, Ph.D.; Marion Lee, Ph.D.; Helen Schaffner, Ph.D.; Barbara Sommer, Ph.D.  
 Biostatistician: Steven Samuels, Ph.D.

Project Manager: Sarah Rowell, M.S.  
Data Manager: Marianne O'Neill Rasor, M.A.

### **Pittsburgh**

Principal Investigator: Karen Matthews, Ph.D.  
Coprincipal Investigator: Jane Cauley, Ph.D.  
Coinvestigators: Joyce Bromberger, Ph.D.; Charlotte Brown, Ph.D.; Kim Sutton-Tyrell, Ph.D.; Sidney Wolfson, M.D.

Data Manager: Nancy Remaley, M.S.I.S.

### **Coordinating Center**

Principal Investigator: Sonja McKinlay, Ph.D.  
Coprincipal Investigator: Sybil Crawford, Ph.D.  
Project Directors: Juli Bradsher, Ph.D.; Kay Johannes, Ph.D.  
Project Manager: Patricia McGaffigan  
Data Coordinator: Beth Willis

### **Laboratory—University of Michigan**

Principal Investigator: Rees Midgley, M.D.  
Coprincipal Investigator: Daniel McConnell, Ph.D.  
Coinvestigator: Barry England, Ph.D.  
Laboratory Manager: Kimberly Gonzalez, M.T.  
Systems Analyst: Mark Davis, B.S.

### **Laboratory—Medical Research Laboratory (MRL)**

Principal Investigator: Evan Stein, M.D.  
Coinvestigator: Paula Steiner

### **Steering Committee Chair**

Jennifer Kelsey, Ph.D.

### **Project Officers**

National Institute on Aging (NIA): Sherry Sherman, Ph.D.; Marcia Ory, Ph.D.  
National Institute of Nursing Research (NINR): Carole Hudgings, Ph.D.

## **APPENDIX B. SPECIFIC SAMPLING AND RECRUITING STRATEGIES BY SITES WITH LIST-BASED PRIMARY SAMPLING FRAMES**

### **A. Boston Site**

The list-based frame used by the Boston SWAN site used the Spring, 1995 Massachusetts Census from all 22 wards in Boston. This census is updated annually and contains the name, address, gender, and age of the residents, but not their race/ethnicity or telephone numbers. The listed age, however, was not always accurate because this census arbitrarily assigns an age if the actual age is missing. Telephone numbers were obtained for some women from Survey Sampling, Inc., the white pages, and directory assistance. Selected tele-

phone numbers were identified through individual contact. The sampling plan was implemented initially by New England Research Institutes, Inc. and subsequently by the California Survey Research Services.

### **B. Chicago Site**

The Chicago Health and Aging Project (CHAP) database, a census of all residents initiated prior to SWAN, served as the sampling frame for the Morgan Park and Beverly neighborhoods in Chicago. The CHAP frame ultimately included the complete name, address, gender, age, and race of individuals. About 1% of records with missing age, gender, or race data on the CHAP frame was excluded from SWAN sampling.

The sampling approach involved stratification by race (African-American and Caucasian). A random number generated from a uniform distribution between 0 and 1 was assigned to each woman in the sampling frame. Subjects were paired with random numbers based on their position in the sampling group. A sampling fraction was computed as the required race-specific sample size divided by the racial/ethnic-specific frame size. Women whose random numbers were less than or equal to the sampling fraction were included in the sample, i.e., simple random sampling was employed within each race stratum.

### **C. Detroit Area Site**

A census was conducted of all households in the 40 target Census Block Groups in the Ypsilanti community and the 46 Census Block Groups in the Inkster community (located in the Detroit area). The sampling frame for the Ypsilanti and Inkster communities was based on a household list from the commercial electric utility company. The list contained every household name and address in the geographical area of interest (100% coverage) but did not include gender, telephone number, age, or ethnicity. The probability of selection for each household was 1. Prior to contacting the household sampling units within a given Block Group, the U.S. Census Block Groups were randomly assigned to sampling batches to minimize selection bias.

In order to contact households, telephone numbers were obtained from cross-matching with the local telephone listing, a reverse telephone directory, and a commercial listing. About 45% of households were matched with a telephone number. Interviewers contacted those households (face to face) without a telephone number to determine if there was an eligible woman in residence, and, if appropriate, conducted the cross-sectional interview. There were more Caucasian women than African-American women in the census

area. Therefore, Caucasian women were subsampled from the Cross-sectional Study for the Longitudinal Study at a rate of 25% using an 8-sided die for the last 8 months of recruitment. The sampling plan was developed and implemented by site investigators and staff.

#### D. Oakland Area Site

The membership list of the Kaiser Permanente Medical Care Program (KPMCP), which insures approximately 30% of the population in the San Francisco Bay area, acted as the sampling frame for the Oakland, California area [12]. This frame included name, age, gender, address, and telephone number, but not race/ethnicity.

From the membership roles, two lists were assembled, one of female members with Chinese surnames and one of female members with non-Chinese surnames [13]. All of the Chinese-surnamed women whose home zip codes mapped to either the Richmond, Oakland, or Hayward Kaiser facilities and who were in the appropriate age range were included ( $n = 2446$ ). The list was randomly ordered using a random number generator and then divided sequentially into batches of 100 and sampled until the cohort recruitment goal of 250 Chinese women was achieved (1400 sampling units required). A similar approach was used for the Caucasian women. In that instance, the list consisted of 4418 women randomly selected from the approximately 47000 non-Chinese-surnamed women members of the appropriate age and residing in the same geographic area. Ultimately, 1650 sampling units were sampled to achieve the cohort recruitment goal of 200 Caucasian women. The sampling plan was developed and implemented by site investigators and staff.

### APPENDIX C. SPECIFIC SAMPLING AND RECRUITING STRATEGIES BY SITES WITH RDD-BASED PRIMARY SAMPLING FRAMES

#### A. Los Angeles Site

The RDD samples from South Bay and Sawtelle in the Los Angeles area were created from the RDD frame maintained by Survey Sampling Institute. The list-assisted random digit dialing method combines a number of available phone lists (including white pages, drivers' licenses, and vehicle registrations) into a Master List of the first eight digits of a phone number (the area code, the exchange, and two more digits). This Master List is expanded by a factor of 100 by adding all possible two-digit sequences (00–99) to each Master List entry. This expanded list can be used directly as

a sampling frame that contains all listed households and a significant portion of the unlisted households. Thus, the sampling frame consists of all phone numbers found in any eight-digit sequence that contains at least one listed telephone number.

To reduce the number of unprofitable (nonhousehold) calls, but at the cost of some bias caused by removing some telephone households from the frame, the expanded list was developed in an abbreviated fashion in the following way. For each eight-digit sequence in the master list, there was a count of the number of listed numbers. The sampler eliminated any sequence with fewer than a specified number of listed numbers. Some market research houses have used a 2+ or a 3+ standard in which sequences with at least two or at least three listed telephone numbers are retained. The Los Angeles site used a 3+ selection method that eliminated residential household blocks with zero, one, or two listed telephone numbers before initiating random sampling. The screening of households was conducted by California Survey Research Services.

Although the Los Angeles SWAN site recruited from census tracts with a higher density of Japanese persons (6–20% of the population) to meet its recruiting goal, the RDD-based sample required supplementation with lists that were devoted entirely to the recruitment of Japanese women. Thus, the Los Angeles site identified all women aged 40–55 years with a first, middle, or family Japanese name from voter registration lists and sampled 100% of these women. The Los Angeles site also used a frame containing listed telephone numbers with Japanese surnames and sampled 100% of these listings. Additionally, the University of California, Los Angeles (UCLA) site also used snowball sampling. The snowball sample for UCLA consisted of referral by Japanese participants of up to five women without regard to the eligibility of that participant.

#### B. Newark Site

The RDD samples for the Newark area were created from the RDD frame maintained by the Survey Sampling Institute, and the screening of households was conducted by California Survey Research Services. Hudson County in New Jersey was stratified into five areas: Hoboken City, Union City, West New York Township, Jersey City, and the remainder of Hudson County so that census tracts containing higher than average densities of Hispanic households could be over-sampled. Random digit dialing was then applied to telephone households in those census tracts. A 3+ selection method was also applied at this site in the same manner as the methodology used at the Los Angeles site.

The New Jersey site also used snowball sampling. In New Jersey, snowball sampling involved asking women who

completed the cohort base line but were ineligible for the cohort to provide the names of up to five women who were cohort age-eligible and who lived in the target areas in Hudson County.

### C. Pittsburgh Site

The major sampling approach implemented at the Pittsburgh site was RDD. Samples of random telephone numbers for households were generated with probability proportional to size across all nonbusiness telephone exchanges (central office codes, or COCs) and working blocks according to the density of the listed residential telephone numbers in the exchange. Area code-COC-working block combinations (including the first eight digits of the area code) and exchange were selected systematically whereas the last two numbers of the 10-digit telephone number were randomly generated. This systematic selection of exchanges (COCs) and working blocks provided a self-weighting, equal-probability sample. The first-stage selection of a telephone number represented the selection of a household. If a household was found to contain more than one age-eligible female, a second-stage randomized selection of a female was made using the birthday method.

The Pittsburgh sites supplemented their RDD sampling with voter registration lists (VRLs) to improve their capacity to oversample their designated ethnic groups and/or target the age group of interest. The VRLs for Pittsburgh included information on gender, birth date, and address for all registered voters and ethnic identification for about 85% of registered voters in Allegheny County. Telephone numbers for the VRL sample were obtained from the Cole Directory for Pittsburgh and Allegheny County, the white pages, and directory assistance. Several different strategies were used; systematic samples were drawn from the voter registration list, including samples reflecting all of Allegheny County

and samples from the 22 zip codes in which a substantial number of African-American women were known to reside.

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