

Kuwait Longitudinal Health Study

Environment and Health in Kuwait

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Chronology of Harvard Involvement

- **1991**
 - Harvard researchers on ground measuring environmental impacts of oil fires
 - Organized international conference on health effects of oil fires and environmental contamination
 - **2002**
 - Harvard selected by Public Authority for Assessment of Compensation to assess public health impacts of Iraq's 1990 invasion, occupation, and assault on Kuwait environment and health care system
 - **2003**
 - Initiated epidemiologic study of long term effects of the war, the Public Health Survey
-

Invasion and Occupation

- 2 August 1990** - Invasion
 - Normal vacation period
 - 17 January 1991** – Air war
 - 10 February 1991** – First Oil Fire
 - 23 February 1991** – Ground War
 - 26 February 1991** - Liberation
 - 7 month occupation
 - 6 November 1991** – Last Oil Fires Extinguished
-

Unique Characteristics

- Complete registry of Kuwaitis from birth to death.
 - Records were carried safely out of the country
 - Invasion during the traditional summer holidays
 - Substantial fraction of Kuwait population out of country
 - Fraction of the population directly exposed to the invasion and occupation
 - Complementary fraction outside of the country did not directly experience the invasion and occupation.
 - Stipend to Kuwaitis who remained in country during invasion and occupation
 - Indicator of exposure to invasion and occupation.
 - After liberation, Kuwaitis encouraged to return
 - Destroyed infrastructure restored
 - Health care and social support systems restored
 - Care and counseling provided
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Kuwaiti National Population

576,861 Kuwaiti Nationals

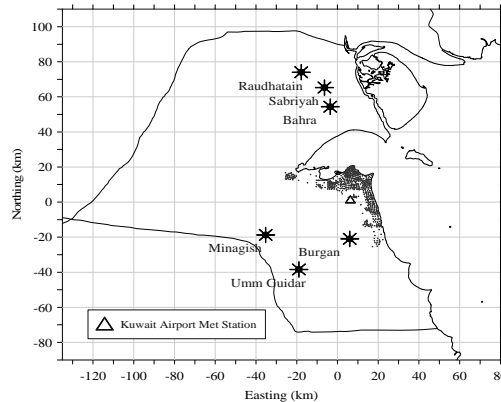
- 16 Feb 1991
- Public Authority for Civil Information Records

Very Young Population

- 47% ≤ 10 Years
- 75% ≤ 25 Years

Many outside of Kuwait during Occupation

- 37% received Stipend for being in Kuwait
- ~ 50% in Kuwait when fires began
- ~ 95% in Kuwait when fires ended



Population Mortality

- Public Authority for Civil Information (PACI)
 - Database of all Kuwaiti nationals alive on the date of liberation (26 February 1991).
- Matched to Ministry of Finance records of those who had received stipend.
 - **In-country** - those who received stipend for remaining in Kuwait during the entire invasion and occupation.
 - **Out-of-country** - those who did not request or receive stipend
- Matched by Civil Identification Number to PACI records of date of death (1991 to 2003).
 - No cause of death

Kuwait Nationals Population

	In country	Out of country
N	212,565	364,296
Person-years	2,527,231	4,363,499
Deaths	10,283	12,357
% deaths population	4.8%	3.4%
Deaths/1000 person-years	4.07	2.83

- Cox PH regression controlled for age, sex, and age*sex interactions
 - HR 1.17 (95% CI 1.14, 1.20) $p < 0.0001$
-

Public Health Survey I

- Living Kuwaiti nationals 50 to 69 years on date of invasion.
 - Random sample stratified by gender, age, and *in-country* and *out-of-country*.
 - Contacted by phone and asked to participate.
 - Written informed consent
 - Face-to-face interviews at home between 3 December 2003 and 29 January 2005.
 - Next of kin for deceased or those unable to answer
 - Questionnaire
 - residence during the invasion and occupation,
 - experiences during the occupation,
 - medical conditions and health care utilization before and after the occupation,
 - date of death for deceased subjects.
-

Public Health Survey

- Exposures during invasion and occupation
 - Self-reports of location
 - In or Out of Kuwait
 - Estimation of exposure to oil fire pollution
 - Self-reports of exposure to violence (as in previous studies)
 - Violence to self
 - Witnessed violence on family or others
 - In hiding (fear)
-

Public Health Survey

- Health events before and after invasion and occupation
 - Mortality
 - Date but not cause
 - Self-reports of physician diagnosed disease
 - Date of diagnosis
 - Self-reports of symptoms
 - Self-reports of hospitalizations
 - Dates and diagnoses
-

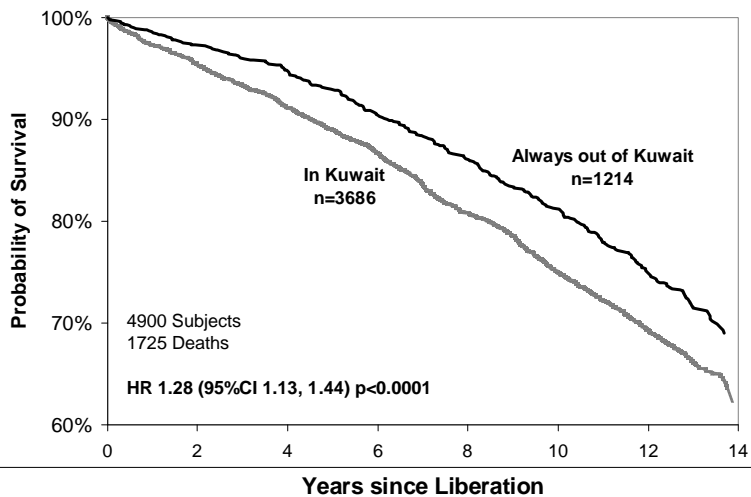
Public Health Survey

□ Individual predictors of disease

- Age and Gender
- Self-reports of socioeconomic status
- History of smoking
- History of chronic diseases
- Obesity indicators
 - Current Body Mass Index
 - Body type currently and prior to invasion
- Diet and exercise

Survival of PHS Participants

Adjusted for sex, age, smoking, education, income, and chronic illness



Hazard Ratio for Cause Specific Death: *Ever In vs Always Out of Kuwait During Invasion and Occupation*

	ICD9	# Deaths	HR	(95% CI)
All Deaths		1573	1.28	(1.13,1.45) p<0.0001
Unknown		344	0.97	(0.76,1.24) p=0.79
Circulatory	390-459	686	1.39	(1.15,1.69) p=0.0007
Neoplasms	140-239	183	1.41	(0.97,2.04) p=0.071
Endocrine	240-279	95	1.31	(0.80,2.14) p=0.29
Respiratory	460-519	67	1.91	(0.94,3.88) p=0.076

Estimates of PM_{2.5} Exposure

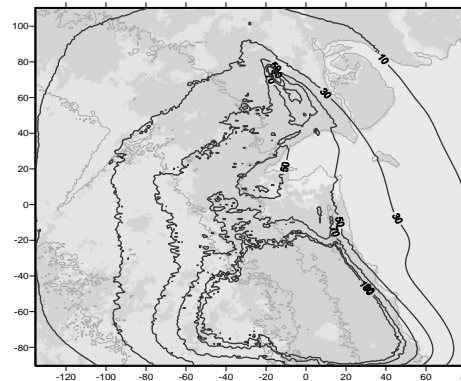
□ CalPUFF Model to Estimate Exposure of Kuwaiti Nationals

- Computed Plume Rise From Thermodynamics of Oil Fires
- Used Improved Meteorological Data and Finer Grid Spacing
- Accounted for Coastal Effects and Considered Plume Enhancement

□ Values Vary Across Country and By Day

- Typical Values ~ 40-50 µg/m³ (in populated areas)
- High Days 600 - 800 µg/m³ (in populated areas)
- Estimated 0.1% increase in deaths from oil fires (p=0.46)

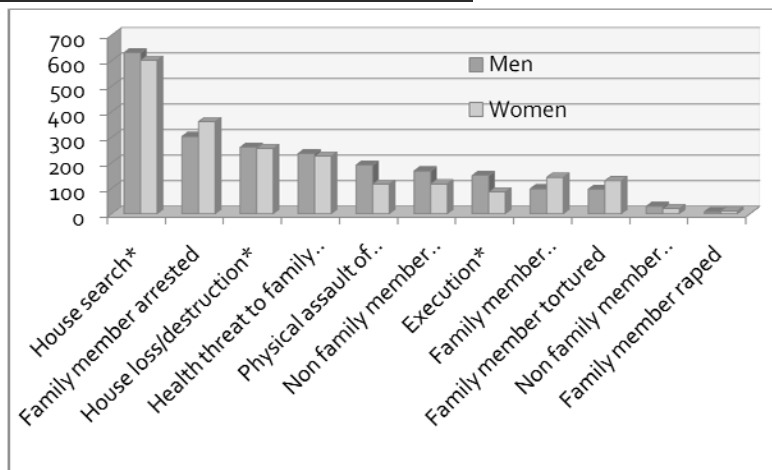
Period Average Contour Plot for All Sources
February 10 - October 15, 1991



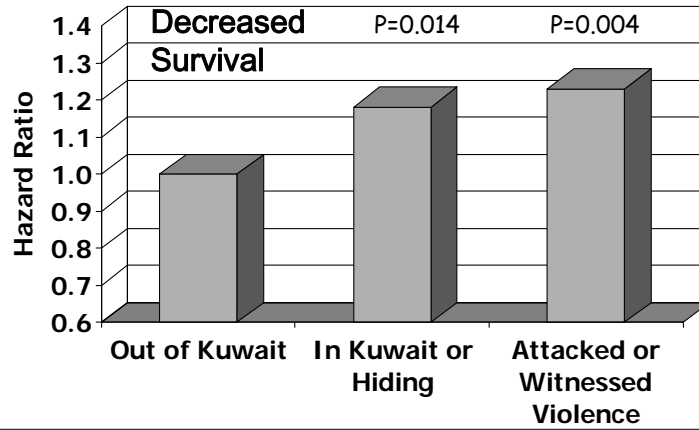
Public Health Survey Results

- Effect of self-reported exposure to violence
 - Attacked or Witnessed Attack (1468 subjects, 30%)
 - Personally arrested or attacked (6%)
 - Witnessed violence to family member (24%)
 - In Kuwait/Hiding (2164 subjects, 44%)
 - In hiding for 3 or more days (6%)
 - In Kuwait but no specific exposure to violence (39%)
 - Out of Kuwait (1254 subjects, 26%)
 - Out of Kuwait entire time (26%)

PHS-I PARTICIPANTS REPORTING WITNESSING SPECIFIC WAR-RELATED EVENTS

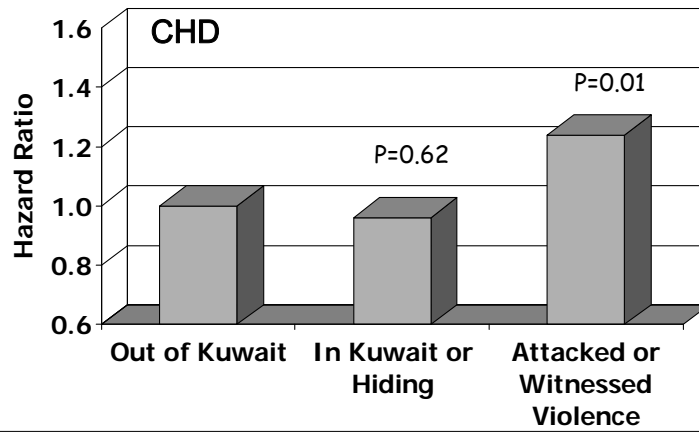


Survival of PHS participants in Kuwait by reported exposure to violence



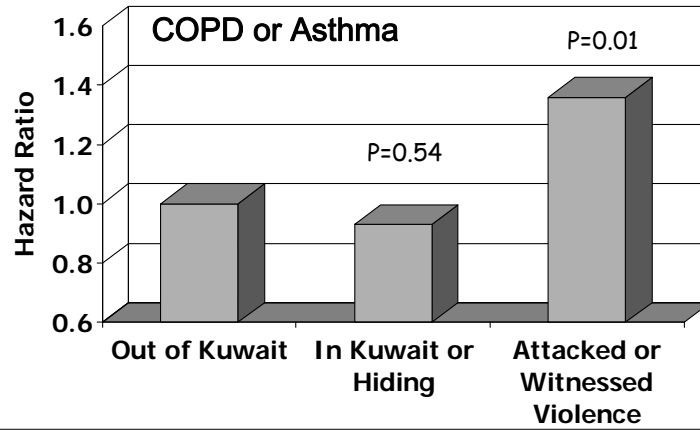
Adjusted for gender, age, smoking, income, and education

Coronary Heart Disease in PHS participants by reported exposure to violence



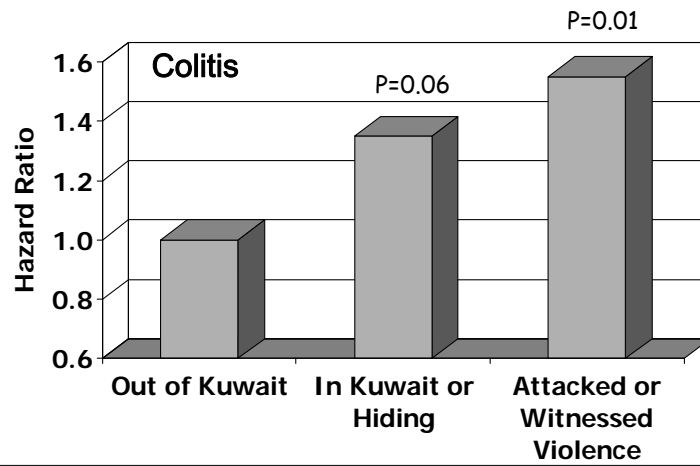
Adjusted for gender, age, smoking, income, and education

Chronic Obstructive Pulmonary Disease or Asthma in PHS participants by reported exposure to violence



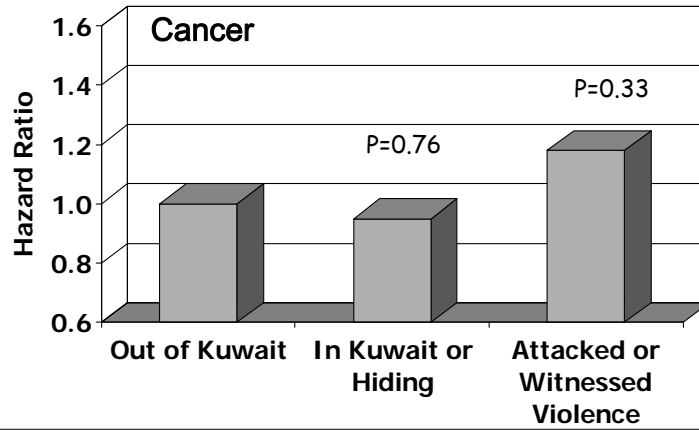
Adjusted for gender, age, smoking, income, and education

Colitis in PHS participants by reported exposure to violence



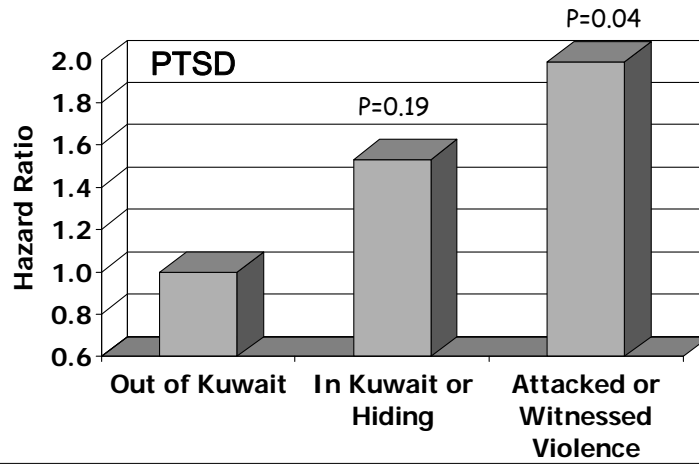
Adjusted for gender, age, smoking, income, and education

Any Cancer in PHS participants by reported exposure to violence



Adjusted for gender, age, smoking, income, and education

Post Traumatic Stress Disorder in PHS participants by reported exposure to violence



Adjusted for gender, age, smoking, income, and education

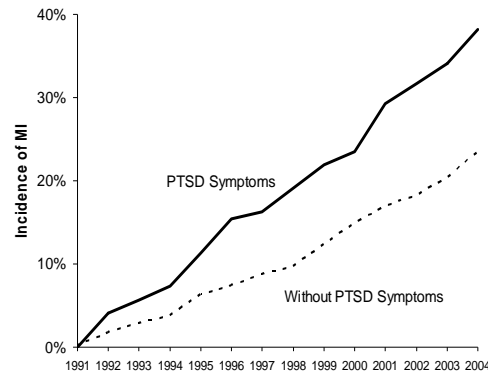
Role of Trauma and Stress:

Heart Attacks and PTSD – PHS Phase I

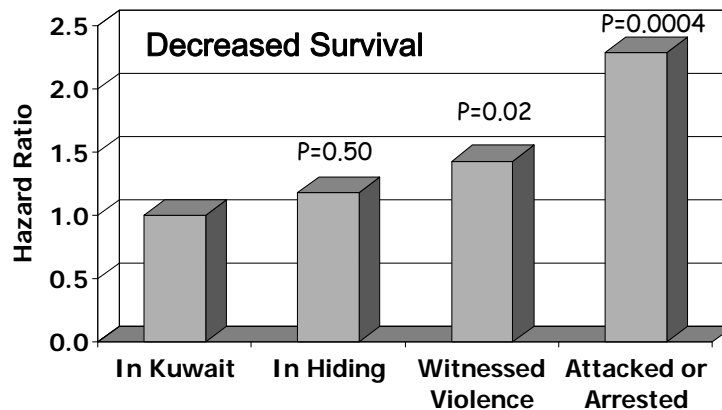
□ Incidence of heart attacks greater among those who experienced symptoms of PTSD.

□ PTSD defined by presence of symptoms in at least two of four groups

- Troubled by unwanted memories or vivid dreams
- Avoid things which remind you of the past
- Feel emotionally numb
- Irritable or “on edge”

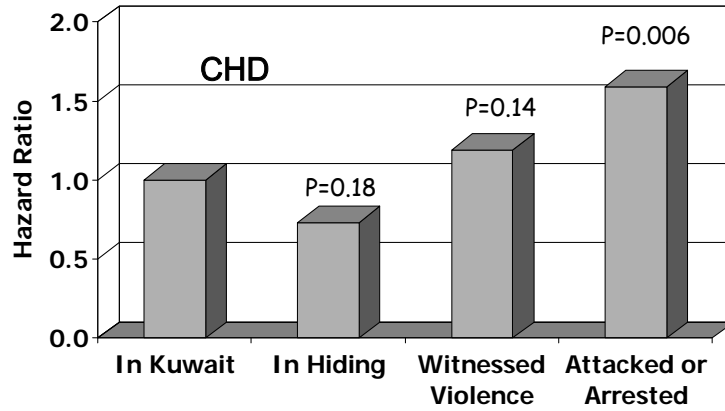


Survival of PHS participants in Kuwait during invasion and occupation by reported exposure to violence



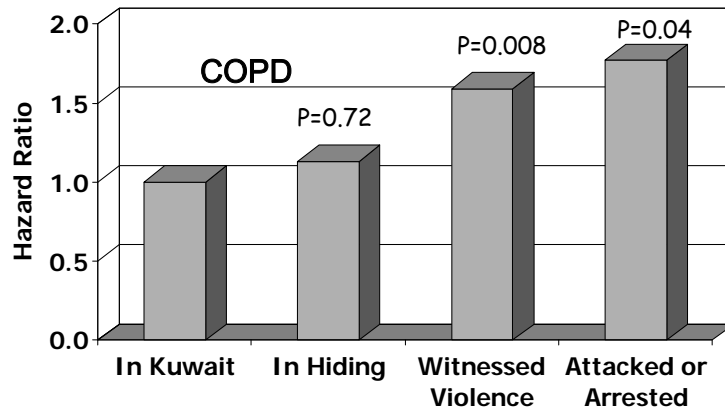
Adjusted for gender, age, smoking, income, and education

Coronary Heart Disease in PHS participants in Kuwait during invasion and occupation by reported exposure to violence



Adjusted for gender, age, smoking, income, and education

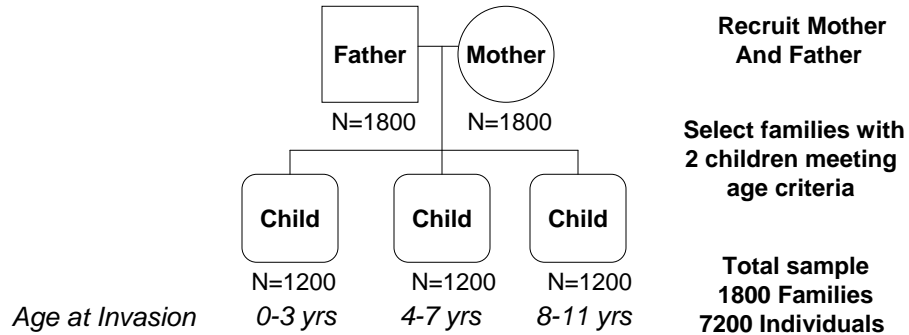
Chronic Obstructive Pulmonary Disease in PHS participants in Kuwait during invasion and occupation by reported exposure to violence



Adjusted for gender, age, smoking, income, and education

Public Health Study- II

Phase II – Children and Their Parents



PHS II Questionnaires

- Individual Characteristics**
 - Age, sex
 - Height and weight
 - Smoking
 - Diet and exercise
- Medical history**
- Date of death**
 - (Deceased only)
- Location**
 - During invasion, occupation and oil fires
- Social/Psychological**
 - Current functioning
 - Depression and anxiety Checklist
 - **Gulf War Syndrome**
 - Social network and support
 - Coping strategies
- Traumatic events**
 - Before and After occupation
 - During occupation
- 64% Participation**

PHS Biologic Markers

- Anthropometry**
 - Height, Weight, and Blood pressure
- Clinical Measures** (fingerstick, 89% participation)
 - Immediate reading
 - Total cholesterol, HDL, LDL, triglycerides
 - Blood glucose (*random*)
 - HgbA1C (*blood sugar control*)
 - C-reactive protein (*systemic inflammation*)
- Future genetic testing**
 - Blood drops stored on treated filter paper
- Hair sample** (*60% of possible*)
 - Environmental metals (*mercury*)
- Salivary cortisol** (*"Children" only, 37% participation*)
 - Measure of stress response

Public Health Survey

PHS I

Men
63-82 yrs
N=2631

Women
63-82
N=2397

Generation I
N=5028

PHS II

Interview Age

Father
50-78 yrs
N=1531

Mother
50-78
N=2286

Generation II
N=3817

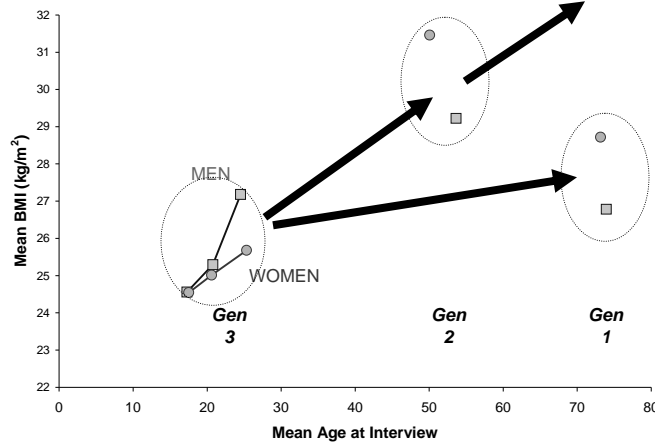
Child
16-19 yrs
N=1278

Child
20-23 yrs
N=1343

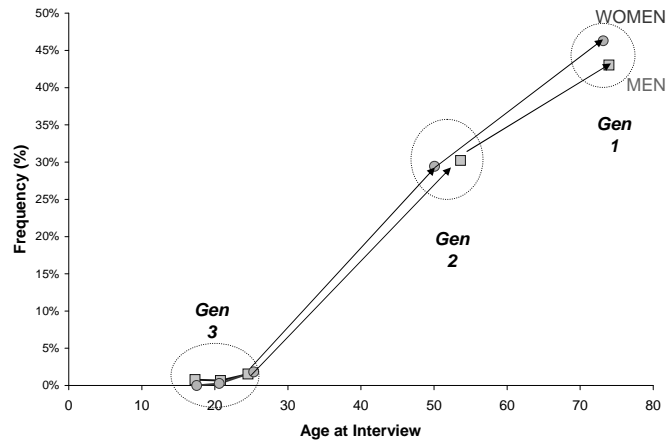
Child
24-27 yrs
N=1322

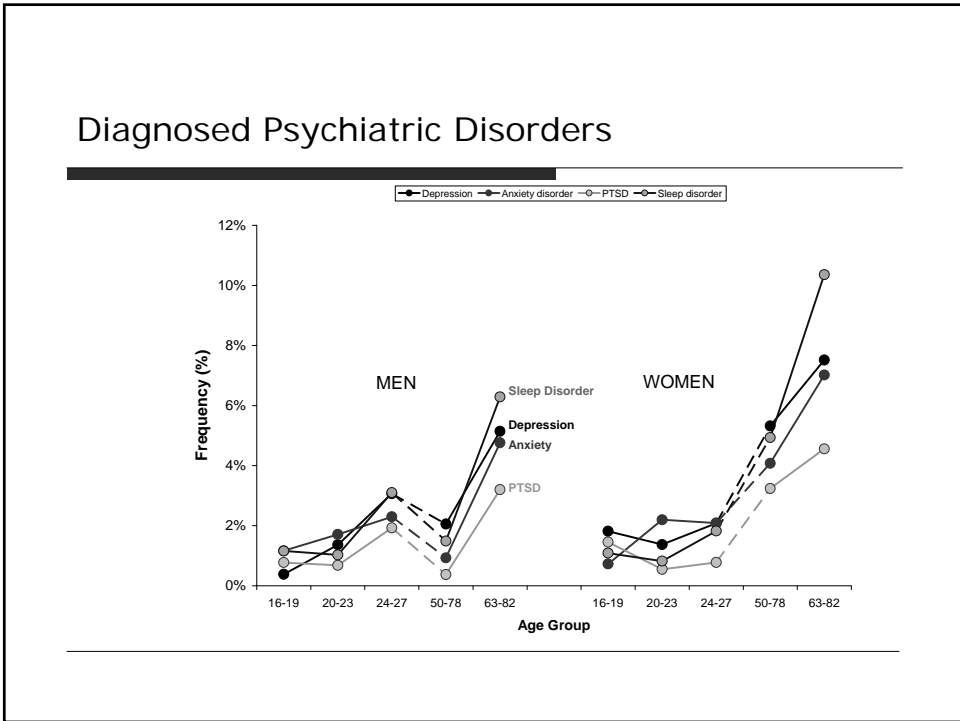
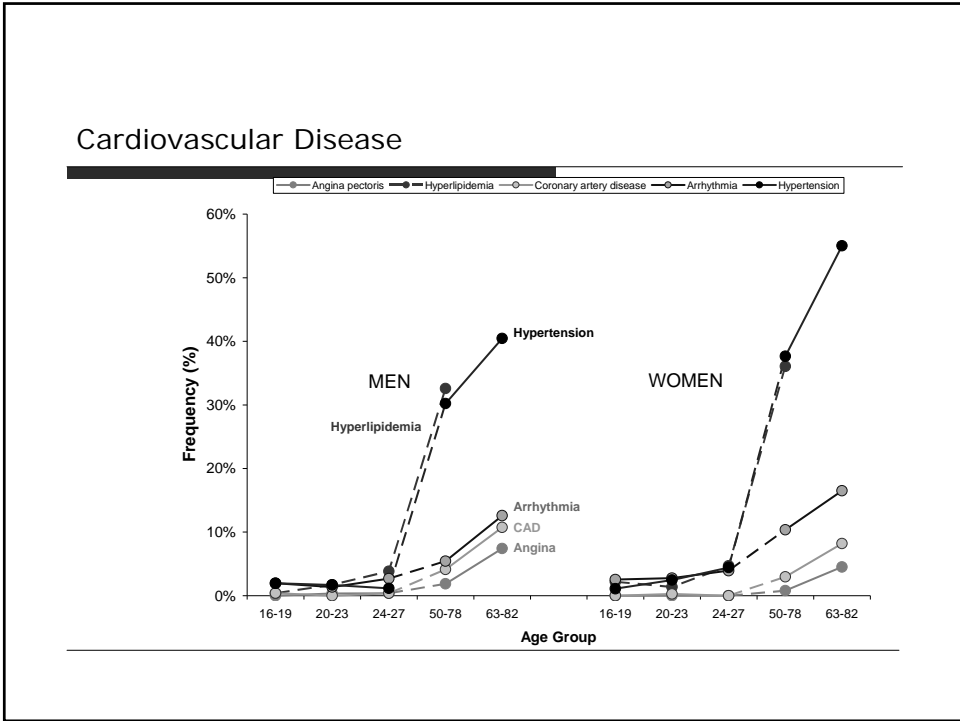
Generation III
N=3943

Mean BMI vs Mean Age by Generation PHS I and II



% Type II Diabetes vs Mean Age by Generation PHS I and II





Gulf War Syndrome Questions

Questions About Your Health

Please indicate below if you have had a persistent problem with each of the following symptoms over the past six months. If you have had the problem, please rate it as mild, moderate, or severe and indicate if it first became a problem before you deployed to the Gulf, or during/after your deployment.

Over the past six months, have you had a persistent problem with ? (Mark NO or YES for each)

	NO	YES	If YES,				
			How would you rate this problem?			When did you first have this problem?	
			Mild	Moderate	Severe	Before Gulf Deployment	During or After Gulf Deployment
Fatigue	<input type="radio"/>	<input type="radio"/> →	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Feeling unwell after physical exercise or exertion	<input type="radio"/>	<input type="radio"/> →	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Problems getting to sleep or staying asleep	<input type="radio"/>	<input type="radio"/> →	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Not feeling rested after you sleep	<input type="radio"/>	<input type="radio"/> →	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pain in your joints	<input type="radio"/>	<input type="radio"/> →	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stiffness in your joints	<input type="radio"/>	<input type="radio"/> →	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pain in your muscles	<input type="radio"/>	<input type="radio"/> →	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Body pain, where you hurt all over	<input type="radio"/>	<input type="radio"/> →	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Gulf War Syndrome Questions

الجزء S: ظاهرة حرب الخليج

هذه قائمة من الأعراض التي يشكو منها بعض الناس أحيانا. لكل من هذه الأعراض، أرجو أن تخبرني إذا كانت لديك مشكلة مستمرة مع هذا العرض عبر الستة أشهر الماضية. إذا كانت لديك مشكلة، أرجو أن تقيّمها ما إذا كانت طفيفة، متوسطة، أو شديدة وأيضا أخبرني متى أصبحت مشكلة بالنسبة لك لأول مرة: قبل الغزو العراقي للكويت في 2 أغسطس 1990، أو بعد هذا التاريخ.

إذا كانت الإجابة نعم		كيف تقيم هذه المشكلة					عبر الستة أشهر الماضية ، هل كان لديك مشكلة دائمة مع؟	
متى حصلت لك أول مرة هذه المشكلة		شديدة	متوسطة	طفيفة	لا	نعم	لا	(ضع علامة عند لا أو نعم لكل واحدة)
أثناء أو بعد حرب الخليج 1991/1990	قبل حرب الخليج 1991/1990							
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/>	<input type="checkbox"/>		S1 الإرهاق
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/>	<input type="checkbox"/>		S2 الشعور بأنك معتدل الصحة بعد التمرينات الرياضية أو الجهد
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/>	<input type="checkbox"/>		S3 مشاكل في النوم أو الإستمرار فيه
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/>	<input type="checkbox"/>		S4 عدم الشعور بالراحة بعد أن تنام
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/>	<input type="checkbox"/>		S5 ألم في مفاصلك
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/>	<input type="checkbox"/>		S6 تصلب في مفاصلك
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/>	<input type="checkbox"/>		S7 ألم في عضلاتك
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/>	<input type="checkbox"/>		S8 ألم وأوجاع في الجسم كله
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/>	<input type="checkbox"/>		S9 صداع
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="checkbox"/>	<input type="checkbox"/>		S10 الشعور بالتعب في يديك أو أعضائك

	Severity			Severity	
	Moderate	Severe		Moderate	Severe
Fatigue	21%	8%	Coughing	8%	3%
Unwell after exercise	13%	6%	Wheezing	6%	2%
Sleep Problems	13%	7%	Sore Throat	6%	3%
Not rested	13%	5%	Sore Glands	3%	2%
Joint pain	17%	13%	Problems Concentrating	10%	4%
Joints stiff	9%	7%	Memory Problems	12%	8%
Muscle pain	13%	6%	Speech Problems	6%	2%
Body Pain	12%	5%	Depression	11%	4%
Headaches	17%	10%	Irritability	15%	9%
Dizziness	11%	4%	Modiness	17%	7%
Light Sensitivity	10%	5%	Anxiety	15%	7%
Blurred vision	8%	3%	Sinus Problems	10%	6%
Numbness	8%	4%	Reduced Taste	1%	1%
Tremors	4%	2%	Swallowing Problems	2%	1%
Temp Sensitivity	9%	5%	Hand-shoulder pain	13%	7%
Night Sweats	7%	4%	Back Problems	14%	11%
Scent Sensitivity	3%	2%	Vomiting	2%	1%
Rashes	5%	2%	Digestive Problems	9%	4%
Skin Problems	6%	3%	Gas	16%	9%
Diarrhea	4%	2%	Arm or leg pain	13%	8%
Nausea	7%	4%	Sickliness	8%	3%
Abdominal Pain	9%	4%	Increased Sleeping	7%	4%
Breathing Trouble	10%	4%	Weakness	5%	2%

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- Kadhema Scientific Consultancy**
 - Abdul Rahman Al-Mulhailan
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 - Dr. Adel Asem
 - Mahmood Yousif
- Kuwait Institute of Scientific Research**
 - Dr. Wajid Sawaya
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