

Blood pressure variation and hypertension rates in a pre-modernized Bedouin population: data from tribes of the Sinai Peninsula (Egypt)

*Variation de la tension artérielle et taux d'hypertension dans une population de
Bédouins non modernisés appartenant aux tribus de la péninsule du Sinai
(Égypte)*

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**BLOOD PRESSURE VARIATION AND HYPERTENSION RATES IN A
PRE-MODERNIZED BEDOUIN POPULATION: DATA FROM TRIBES
OF THE SINAI PENINSULA (EGYPT)**

**VARIATION DE LA TENSION ARTÉRIELLE ET TAUX
D'HYPERTENSION DANS UNE POPULATION DE BÉDOUINS
NON MODERNISÉS APPARTENANT AUX TRIBUS
DE LA PÉNINSULE DU SINAI (ÉGYPTE)**

H. MONK-VITELSON ¹, I. HERSHKOVITZ ¹, E. KOBYLIANSKY ¹

ABSTRACT

During the 20th century Bedouin society has shifted from semi-nomad pastoralism toward a more Western life style, whilst accumulating risk factors for life threatening diseases. This is evident from recent reports of hypertension and obesity in Bedouin groups.

In face of this epidemiological transition, it is important to document blood pressure (BP) values and related anthropometrics of Bedouin tribes prior to considerable exposure to modernization. The *Towara* tribes of the Sinai Peninsula represent traditional Bedouin subsistence and culture.

The *Towara* sample includes 318 men and 91 women, age 17 up to 85 years. Mean BP values of *Towara* men and women are 121/81 and 111/76, respectively. The overall rates of hypertension (HTN, defined as the percent of persons with systolic BP \geq 140 and/or diastolic BP \geq 90 mmHg) are 12% for males and 4% for females. BMI is 20 kg/m² for both sexes. Blood pressure values and HTN rates of the *Towara* males and females are found to be low when compared to other Bedouin and Arab groups of the Middle East.

Inter-tribal comparison considers only young adults: ages 20-39 years for men and 17-39 for women. Females of the *Muzeina* tribe have exceptionally low BP values: 108/76 mmHg, while *Muzeina* males (BP: 122/80 mmHg) are not distinguishable from other *Towara* groups. HTN rates in the 4 male tribal groups range between 6% and 20%.

No consistent age-dependent increase is evident for males in either BP or HTN rates, although for both traits the youngest *Towara* men (17-19 years) have lower values than the oldest group (50+): 117/79 vs. 125/86, and 5% vs. 19%. Female samples do not allow for effective comparison, however only 3 *Towara* women were found to have HTN.

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The low values of BP and HTN rates reflect the traditional subsistence of Towara population and can serve as a reference for comparison along the modernization process.

Keywords: blood pressure, hypertension, BMI, anthropometry, Bedouin, tribe, semi-nomads, pastoralists, modernization.

RÉSUMÉ

Au cours du 20^e s., la société bédouine est passée d'un mode de vie d'éleveurs semi-nomades à un mode de vie plus occidental, ce qui a entraîné une augmentation des facteurs de risque au regard de maladies mettant la vie en danger, comme le démontrent des études récentes sur l'hypertension et l'obésité dans les groupes bédouins.

Face à cette transition épidémiologique, il nous a paru important d'analyser, chez les Bédouins, les valeurs de la tension artérielle (BP) et les données anthropométriques associées, avant que les tribus ne soient soumises à la modernisation. Les tribus Towara de la péninsule du Sinaï représentent le mode de vie bédouin traditionnel.

L'échantillon étudié comprend 318 hommes et 91 femmes âgés de 17 à 85 ans. La valeur moyenne de la tension artérielle est de 121/81 pour les hommes et de 111/76 pour les femmes. Le taux global d'hypertension (HTN), défini comme la proportion d'individus ayant une tension systolique ≥ 140 et/ou une tension diastolique ≥ 90 mmHg est de 12 % pour les hommes et de 4 % pour les femmes. L'indice de masse corporelle est de 20 kg/m^2 pour les deux sexes. Les valeurs de la tension et le taux d'hypertension sont peu élevés chez les Towara en comparaison avec les autres groupes bédouins et arabes du Moyen-Orient.

Les comparaisons inter-tribales ne concernent que les adultes jeunes (20-39 ans pour les hommes et 17-39 ans pour les femmes). Les femmes de la tribu Muzeina présentent des valeurs de tension artérielle exceptionnellement basses (108/76 mmHg) alors que les hommes de cette tribu (tension moyenne de 122/80 mmHg) ne se distinguent pas des autres groupes Towara. Dans les 4 groupes d'hommes étudiés, le taux global d'hypertension varie de 6 % à 20 %.

Il n'a pas été possible de démontrer que la tension et le taux d'hypertension augmentait avec l'âge, bien que les hommes Towara les plus jeunes (17-19 ans) présentent, pour ces deux caractères, des valeurs moins élevées que les hommes du groupe le plus âgé (50+) : 117/79 contre 125/86 et 5 % contre 19 %. Les échantillons de femmes ne permettent aucune comparaison ; signalons néanmoins que 3 femmes Towara seulement étaient atteintes d'hypertension.

Les valeurs peu élevées de la tension artérielle et du taux d'hypertension reflètent le mode de vie traditionnel de la population Towara et peuvent servir de référence pour effectuer des comparaisons tout au long du processus de modernisation.

Mots-clés : tension artérielle, hypertension, indice de masse corporelle, anthropométrie, Bédouins, tribu, semi-nomades, pasteurs, modernisation.

During the 20th century, Bedouin groups throughout the Middle East have experienced rapid socio-cultural changes. In general, Bedouin mode of living has shifted from semi-nomad pastoralism toward more settled and more Western life style, and it is well established that such transitions are accompanied by considerable biological changes.

In recent years, we witnessed the increasing frequency of reports concerning elevated blood pressure (hypertension), overweight, and other risk factors for life threatening morbidity across Bedouin populations all over the Middle East (Fraser *et al.*, 1990; Paran *et al.*, 1992; el Mugamer *et al.*, 1995; Pilpel *et al.*, 1995; Soyannow *et al.*, 1997; al-Mahroos and al-Roomi, 1999; Jaddou *et al.*, 2000). In face of this trend it is worthwhile to introduce some basic values of blood pressure and physique measured in a group of Bedouin tribes prior to substantial exposure to modernization agents.

The population presented in this study is the *Towara* tribal affiliation, which inhabits the southern, mountainous region of the Sinai Peninsula. Geo-political circumstances have maintained this area in a relative isolation from Western influences, so that at the time of data collection, local economy was based on desert herding and other traditional sources of living such as palm tree cultivating, fishing, smuggling, some wage labor and international welfare (Marx, 1984). Institutions like high schools or hospitals were unavailable in the entire region, and for the majority of the 12,000 *Towara* Bedouins, running water, paved roads and electricity were novel (Kobyliansky and Hershkovitz, 1997).

During the Israeli regime in the region between 1967-1982, the indigenous population has focused much scientific attention. Studies have documented the dietary intake of *Towara* Bedouins (Nir, 1985; Pervolotsky and Pervolotsky, 1979, cited by Kobyliansky and Hershkovitz, 1997; Pervolotsky, 1987), their genetic profile (Bonne, 1973) and anthropometric variation (Arensburg *et al.*, 1979; Kobyliansky and Hershkovitz, 1997, 2002; Monk *et al.*, 2000). However, studies concerning the physiology of the *Towara* population have not been published.

The aim of the present study is to present values of blood pressure and related traits in a traditional, pre-modernized Bedouin society. These data might serve as a reference for comparison with corresponding values in different stages of modernization.

METHODS

The data presented here originate in a comprehensive field survey carried out in South Sinai during 1978-1980 by the staff of the Department of Anatomy and Anthropology, Sackler School of Medicine, Tel Aviv University (See Arensburg *et al.*, 1979; Kobyliansky and Hershkovitz, 1997, 2002).

The sample included 318 Bedouin males and 91 Bedouin females, aged 17-85 years. Female's samples are smaller due to high sensitivity of the Bedouin society to physical examination of women.

Physiologic and anthropometric traits were measured according to standard procedures (see Kobyliansky and Hershkovitz, 1997). Rate of hypertension was

calculated as percentage of persons with systolic blood pressure of 140 mmHg and over, and/or diastolic values of 90 mmHg and over. Samples of the two largest *Towara* tribes (*Muzeina* and *Gebelia*) are considered separately, while samples of the smaller tribes had to be pooled together to form units sufficient for statistical analysis. Female samples from all *Towara* tribes other than *Gebelia* and *Muzeina* were gathered to form the *Other Towara* sample. The larger male samples allowed differentiation of an additional tribal group: *Aleigat* and *Hamada*, a couple of biologically and geographically related tribes. Male members of all smaller tribes (*Gararshe*, *Sawalha*, *Bani-Wasel*, *Awlad-Said*, *Hweitat* and *Ahali-A-Tur*) comprise the *Other Towara* sample.

Data are presented according to age groups. Once again, male samples allow better resolution, while female samples, even when divided to 3 age groups are minute.

In order to reduce the variability stemming from age dependant factors, inter-tribal variation is evaluated by comparing means of the relatively homogenous age groups of young adults: 20-39 years in males, and 17-39 years in females (females mature earlier, thus late teenagers are supposed to reach their adult values, as opposed to males whose growth continue throughout the 2nd decade of life).

A one-way analysis of variance was carried out for subdivisions of age groups and tribal affiliation. Scheffe's multiple range test was applied to determine separability of subgroups' means.

Some comparative data of neighbouring Bedouin and other Arab groups, as well as reference European group are presented for estimation of the relative position of *Towara* males and females.

RESULTS

Tribal differences among *Towara* people are considered for the relatively homogenous age group of young adults (20-39 years for males, 17-39 years for females, *tabl. 1,2*). Mean systolic and diastolic values of males in four tribal groups range from 117 to 125 mmHg, and from 79 to 86, respectively, with some inter-tribal differences: *Gebelia* men, residing in the high mountain region, have the highest mean systolic pressure and the highest rate of hypertension, while at the same time their mean diastolic pressure is lowest (*tabl. 1*).

Mean BMI of all 4 male groups is very close to 20, ranging from 19.7 to 20.4, with no significant inter-tribal differences (*tabl. 1*). Female range is larger: 18.9-22.2, with mean BMI of *Muzeina* being significantly lowest (*tabl. 2*). For the traits related to blood pressure, *Muzeina* females essentially constitute the entire *Towara* sample, with exceptionally low values of blood pressure (108/76). Rate of hypertension of *Muzeina* females aged 17-39 is close to 4% (*tab. 2*).

	MUZEINA			GEBELIA			ALEIGAT-HAMADA			OTHER TOWARA			Scheffe's subsets	p
	n	mean	sd	n	mean	sd	n	mean	sd	n	mean	sd		
Systolic BP	75	121.6	12.1	55	125.3	13.2	34	117.4	10.1	48	122.5	10.6	I (3,1,4) II (1,4,2)	0.02
Diastolic BP	75	79.9	9.6	56	78.5	10.9	34	81.6	8.8	48	85.8	10.0	I (2,1,3) II (3,4)	0.00
Rate of hypertension*	-	9.3	-	-	20	-	-	6.0	-	-	14.6	-	-	-
Weight (kg)	104	56.8	7.6	101	58.0	7.9	38	56.6	9.4	75	54.9	7.1	I (4,3,1,2)	n.s.
BMI	103	20.0	2.1	100	20.4	2.4	37	19.8	2.3	71	19.7	2.0	I (4,3,1,2)	n.s.
Triceps SF	66	7.0	3.2	74	9.5	3.6	-	n.d.	-	32	8.9	2.8	I (1,4) II (4,2)	0.00

Tabl. 1 - Sample sizes (n), means, standard deviations (sd) and ANOVA results (p) for blood pressure (BP) values and anthropometric traits of Bedouin males, age 20-39 in 4 subgroups of Towara tribal affiliation, Sinai Peninsula.

	MUZEINA			GEBELIA			OTHER TOWARA			Scheffe's subsets	p
	n	mean	sd	n	mean	sd	n	mean	sd		
Systolic BP	49	108.3	10.2	5	120.0	14.6	-	n.d.	-	I (1,2)	0.05
Diastolic BP	52	75.5	7.6	5	77.0	5.7	-	n.d.	-	I (1,2)	n.s.
Rate of hypertension*	-	4.0	-	-	0.0	-	-	-	-	-	-
Weight (kg)	51	46.6	6.0	7	54.6	8.1	15	56.0	8.8	I (1) II (2,3)	0.00
BMI	49	18.9	1.9	7	22.2	2.5	15	21.9	3.0	I (1) II (3,2)	0.00

Tabl. 2 - Sample sizes (n), means, standard deviations (sd) and ANOVA results (p) for blood pressure (BP) values and anthropometric traits of Bedouin females, age 17-39 in 3 subgroups of Towara tribal affiliation, Sinai Peninsula.

* Percent of cases with blood pressure values ≥ 140 and/or ≥ 90 mmHg.

n.d. - no data available

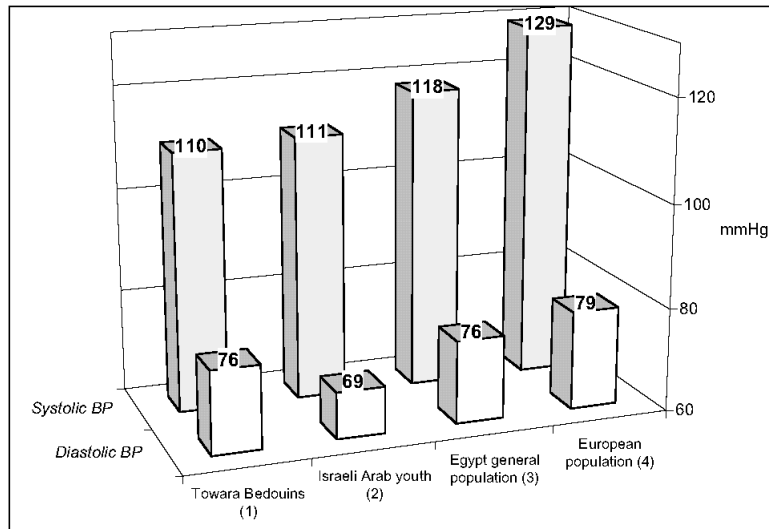
n.s. - not statistically significant ($p > 0.05$)

BP - Blood pressure (mmHg)

SF - Skin fold thickness (mm)

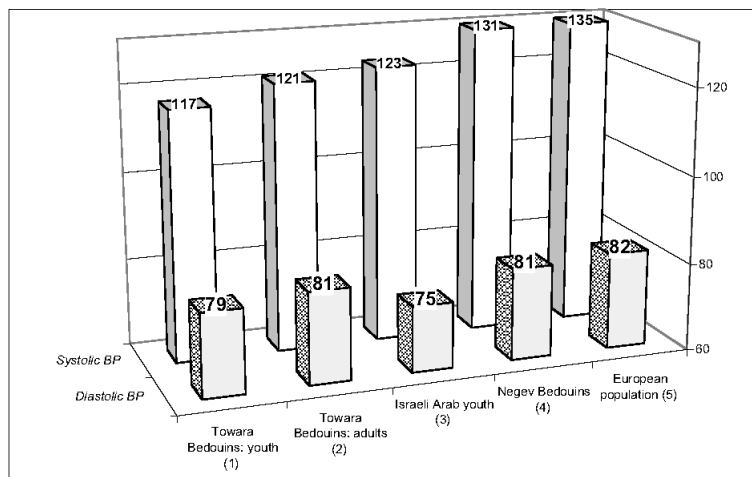
BMI - Body mass index (kg/m^2)

When compared to other groups of Arabs living in neighbouring countries, Towara Bedouins have low blood pressure values (fig. 1,2) and low rates of hypertension (fig. 3,4).



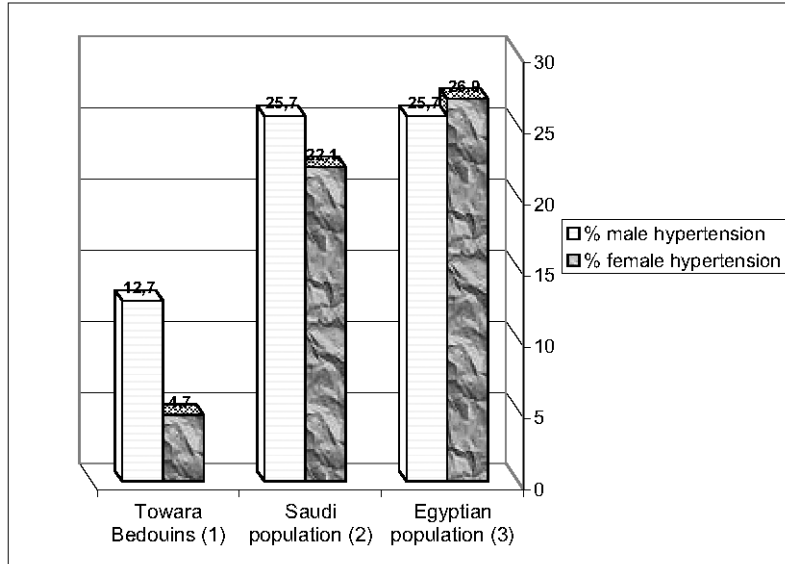
Age groups and references:
 1. 20-39y, present study
 2. 17y, Jaber et al. 2000
 3. 25-34y, Ibrahim et al. 1995
 4. 25-64y, De Henauw et al. 1998 (Belgium)

Fig. 1 - Mean systolic and diastolic blood pressure values (in mmHg) of 4 female groups, ordered from lowest to highest systolic pressure.



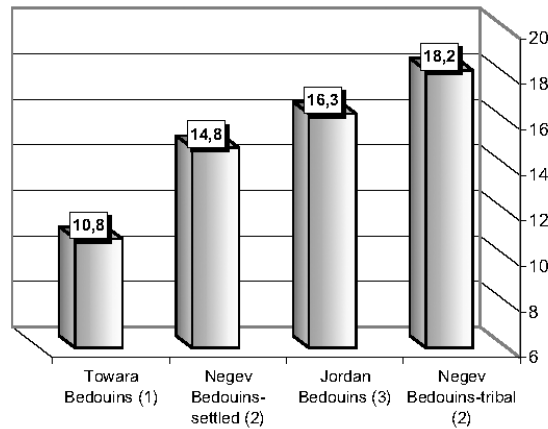
Age groups and references:
 1. 17-19y, present study
 2. 20y and over, present study
 3. 17y, Jaber et al. 2000
 4. 30y and over, Fraser et al. 1990 (Israel)
 5. 25-64, De Henauw et al. 1998 (Belgium)

Fig. 2 - Mean systolic and diastolic blood pressure values (in mmHg) of 5 male groups, ordered from lowest to highest systolic pressure.



Groups and references:
 1. 20y and over, present study.
 2. 19y and over, Soyannow et al., 1997.
 3. 25y and over, Ibrahim et al., 1995.

Fig. 3 - Rate of male and female hypertension (defined as blood pressure $\geq 140/90$ mmHg) in 3 neighbouring Arab groups.



Groups and references:
 1. Males 30y and over, present study.
 2. Males 30y and over, Israel, Fraser et al., 1990.
 3. Recently urbanised adults 25y and over (no gender effect on hypertension rate), Jaddou et al., 2000.

Fig. 4 - Rate of hypertension (defined as blood pressure $\geq 160/95$ mmHg) in 4 Bedouin groups.

Tables 3-4 display data of *Towara* male and female (respectively) according to age groups and regardless of tribal origin. Among males, for all traits the mean values at 20-39 years are higher than those at 17-19 years, but this age-dependent increase continues throughout the age range only for BMI and Triceps skin-fold thickness. The highest mean blood pressure (125/86) and the highest hypertension rate (18.8%), belongs to the oldest group (50+), although Scheffe's multiple range test does not support the separability of means for blood pressure. Female samples are small, indicating age-dependent increase in most traits. Mean blood pressure of the oldest group (40+) is 117/81 and values of the youngest group (17-19 years) are 107/74, however none of the differences reach the level of statistical significance, probably due to the small samples of the youngest and oldest age groups.

	17-19			20-39			40-49			50+			Scheffe's subsets	p
	n	mean	sd	n	mean	sd	n	mean	sd	n	mean	sd		
Systolic BP	41	117.2	9.7	213	122.1	12.0	37	116.0	12.8	16	124.7	12.3	I(3,1,2,4)	0.00
Diastolic BP	40	78.9	9.5	203	81.1	10.2	38	81.8	10.1	16	85.6	7.3	I(1,2,3,4)	n.s.
Rate of hypertension*	-	4.9	-	-	13.0	-	-	10.7	-	-	18.8	-	-	-
Weight (kg)	74	51.9	5.8	319	56.7	7.8	57	58.5	8.9	22	57.1	8.8	I(1,2,4) II(2,4,3)	0.00
BMI	74	18.6	1.4	312	20.1	2.2	56	21.0	2.5	20	21.4	2.6	I(1) II(2,3,4)	0.00
Triceps SF	37	7.7	2.8	173	8.4	3.5	29	9.4	1.0	17	9.5	2.1	I(1,2,3,4)	n.s.

Tabl. 3 - Sample sizes (n), means, standard deviations (sd) and ANOVA results (p) for blood pressure (BP) values and anthropometric traits of *Towara* Bedouin males by age groups (years).

	17-19			20-39			40+			Scheffe's subsets	p
	n	mean	sd	n	mean	sd	n	mean	sd		
Systolic BP	5	107.0	4.5	50	109.8	11.5	10	116.5	12.3	I(1,2,3)	n.s.
Diastolic BP	5	74.0	5.5	53	75.9	7.5	11	80.5	8.5	I(1,2,3)	n.s.
Rate of hypertension*	-	0.0	-	-	3.9	-	-	9.5	-	-	-
Weight (kg)	6	52.8	9.6	67	49.0	7.8	18	50.1	6.7	I(2,3,1)	n.s.
BMI	5	19.5	2.9	66	19.9	2.6	18	21.7	2.9	I(1,2,3)	0.05

* Percent of cases with blood pressure values ≥ 140 and/or ≥ 90 mmHg

n.d. - no data available

n.s. - not statistically significant ($p > 0.05$)

BP - Blood pressure (mmHg)

SF - Skin fold thickness (mm)

BMI - Body mass index (kg/m^2)

Tabl. 4 - Sample sizes (n), means, standard deviations (sd) and ANOVA results (p) for blood pressure values and anthropometric traits of *Towara* Bedouin females by age groups (years).

DISCUSSION

Towara Bedouins have been dwelling in the Southern region of the Sinai Peninsula for many generations. In fact, these semi-nomad tribes are the only permanent inhabitants of this desolated region (Marx, 1984; Kobylansky and Hershkovitz, 1997, 2002).

Low values of blood pressure and body mass are documented in the present study for various segments of the *Towara* population. Mean values of systolic blood pressure for men of all tribal groups and of all age groups range between 115-125 mmHg, and diastolic values between 78-85 mmHg. Females' mean values are even lower: 107-120 and 74-80 for systolic and diastolic values, respectively. The overall hypertension rates are 12% for males and 4% for females. Mean BMI range between 18-22 kg/m² in both sexes. These values are typical to tribal, pre-modernized populations (Pauletto *et al.*, 1994, 1996; Kaufman *et al.*, 1999), yet our findings are in contrast to many recent reports of Bedouin groups throughout the Middle East.

Starting in the early 1990s there is a widening stream of publications concerning high prevalence of hypertension and obesity among Bedouins at various stages of the modernization process from Israel (Fraser *et al.*, 1990; Paran *et al.*, 1992; Pilpel *et al.*, 1995), Jordan (Jaddou *et al.*, 2000), Saudi Arabia (Soyannow *et al.*, 1997), the United Arab Emirate (el Mugamer *et al.*, 1995), and additional regions of the Arabian Peninsula (al-Mahroos and al-Roomi, 1999). The findings of increased body mass and blood pressure among Bedouins is said to reflect the rapid transition experienced by these populations along the 20th century, moving from semi-nomadic pastoralist subsistence to a more Western mode of life.

Although modernization has affected the entire Middle East, some Bedouin groups were influenced to a large extent while others were minimally exposed, and this can be expressed in the distribution of blood pressure values. The southern region of the Sinai Peninsula is clearly an area that remained peripheral to major geo-political and socio-cultural changes. Our data were obtained in the late 1970s, when South Sinai was to a great extent isolated from the Western world. Paved roads, running water and electricity had just been introduced to the region. Reports of the diet of contemporaneous *Towara* Bedouins can shed some light over the low values of blood pressure, as they reveal poor intake of carbohydrates, fat, and sodium, besides low intake of proteins (Nir, 1985; Pervolotsky and Pervolotsky, 1979, cited by Kobylansky and Hershkovitz, 1997; Pervolotsky, 1987).

It has been shown elsewhere that despite the poor living conditions of *Towara* Bedouins, gradual exposure to agents of the Western world did occur, and *Towara* men demonstrated secular increase in stature along the 20th century (Field, 1952; Monk *et al.*, 2000). The issue of secular trend among *Towara* women is less clear, for lack of earlier

reports of their physique. We inferred a considerable delay in the exposure of *Towara* women to improved environmental conditions (Monk *et al.*, 2000).

Regarding blood pressure and body mass of the *Towara* population, we have no earlier data for comparison, and we can only assess them in relation to other groups. The closest groups available for comparison are 2 samples of male Bedouins from the Israeli Negev studied during 1985-1986 (Fraser *et al.*, 1990). The samples are differentiated by their life style, defined as “settled” *versus* “tribal”. Mean blood pressure values of the 2 groups are similar (131/80 *vs.* 132/82), despite significantly higher mean BMI of the former (25 *vs.* 23), and lower hypertension rate of the later (18.2 *vs.* 14.8). The authors report increase in ischaemic heart diseases among Negev Bedouins, starting in the 1970s (Fraser *et al.*, 1990). Mean systolic value as well as mean BMI in both Negev groups are higher than any of the mean values recorded among *Towara* subgroups.

Another source for comparison is the Egyptian National Hypertension Project carried out in the early 1990s, where blood pressure values of both men and women are close to 120/80 for the age range of 25-44 years, and approach 130/80 for age 45-54 years (Ibrahim *et al.*, 1995, Ibrahim, 1996). Blood pressure values of *Towara* men are quite similar to those of the general Egyptian population, however, blood pressure distribution in the present study is rather different in at least three ways: first, blood pressure of *Towara* women is considerably lower than their male counterparts, and second, there is no clear age related increase in blood pressure. The third and most prominent difference concerns the rate of hypertension, which exceeds 25% in the Egyptian population. Similar rates were reported for a Saudi population (Soyannow *et al.*, 1997) and for Arab Israelis (Amad *et al.*, 1996), as opposed to *Towara* Bedouins, with less than 5% female hypertension, and less than 13% male hypertension.

These three characteristics of blood pressure variation, namely distinct sex dimorphism, blurred age increments, and low hypertension rates, further indicate the traditional nature of the studied population (Dressler, 1999; Gerber and Stern, 1999; Stevenson, 1999).

To conclude, the present study examines blood pressure variation in a traditional, pre-modernized semi-nomad Bedouin group of tribes, inhabiting a desolated region of the Sinai Peninsula. The low level of blood pressure values and hypertension rates recorded in the *Towara* population, attest to the minimal amount of exposure to modern lifestyle.

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