Peer-reviewed version available at Int. J. Environ. Res. Public Health 2018, 15, 315; doi:10.3390/ijerph15020315

Article

A Comprehensive Health Profile of Youths Living with a "Hikikomori" Lifestyle

John W. M. Yuen [1,*], Yoyo K. Y. Yan [1], Victor C. W. Wong [2], Wilson W. S. Tam [3], Ka-Wing So [4] and Wai-Tong Chien [1]

[1] School of Nursing, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong Special Administrative Region; E-Mails: john.yuen@polyu.edu.hk (J.W.M.Y.); yoyo.ky.yan@polyu.edu.hk (Y.K.Y.Y.); wai.tong.chien@polyu.edu.hk (W.T.C.)
[2] Department of Social Work, Hong Kong Baptist University, Kowloon Tong, Kowloon, Hong Kong Special Administrative Region; E-Mail: vicwong@hkbu.edu.hk
[3] Alice Lee Centre for Nursing Studies, National University of Singapore, Singapore; E-Mail: wilson_tam@nuhs.edu.sg
[4] Withdrawal Youth Service, Hong Kong Christian Service, Tsim Sha Tsui, Kowloon, Hong Kong Special Administrative Region; E-Mail: sokawing@hkcs.org
* Correspondence: john.yuen@polyu.edu.hk; Tel.: +852-2766-4130; Fax: +852-2364-9663.

Abstract: To understand the health impacts of "hikikomori" lifestyle and to establish its first comprehensive health profile, a cross-sectional study was designed to measure how well the cases of hikikomori youths of Hong Kong were living, in terms of social, mental and physical aspects. This study involved 104 eligible participants at age 19.02 year-old who had completed the set of questionnaires and a series of anthropometric and physical health measurements. Despite SF36 score of 84.0 indicated good physical functioning in general, participants were lived sedentarily with high incidence of hypertension at 15.4% and prehypertension at 31.7%. Occurrence of hypertension in cases living as hikikomori >6 months was 3-times higher than those newly onset cases. The blood pressure levels were correlated with age and all obesity index parameters measured including waist circumference and body mass index. Half of the hypertensive cases involved the elevation of systolic blood pressure, which suggested higher odds of cardiovascular complications. Participants were mentally stable living with moderate levels of perceived stress and state anxiety, but borderline clinical depression. In conclusion, the hikikomori lifestyle could be a risk behavior that may harm the younger generation physically by promoting obesity and hypertension and probably other chronic illnesses.

Keywords: hikikomori; hidden youth; social withdrawal; health; hypertension; obesity; adolescent; physical health

1. Introduction

The pandemic of "hikikomori" has alerted public health experts worldwide, particularly on the psychological well-beings of young generation [1,2]. In Japan, the lifetime prevalence rate of hikikomori was estimated as 1.2% [3], which was comparable with the prevalence of 1.9% reported in Hong Kong according to a recent telephone-based survey [4]. Such local prevalence was close to the initial estimation made by a non-governmental organization that projected 18,500 hikikomori cases (accounted for 2.1% of its youth population) were living in the city [5]. As a severe form of social withdrawal, hikikomori represents typically hidden youths who are having protracted period of hermetic life at home. The universal definition adopts any individual without a clear or legitimate purpose who are confining themselves at home, avoiding face-to-face contact with others except family or the closest person, and having a 'Zero Status' – meaning is not in education, training, or work [6]. Hikikomori cases have been identified in numerous Western [7-9] and Asian countries [3,6,10]. Most cases were discovered at age of early-20s while onset could be the earliest during the

Peer-reviewed version available at Int. J. Environ. Res. Public Health 2018, 15, 315; doi:10.3390/ijerph15020315

junior high school period [5,11-13]. Although the etiology remains largely unknown, many researchers believed that this is a personalized phenomenon and cultural driven. A few studies [10,14-16] had reported low self-esteem characteristics of hikikomori and many of these cases were living unhappily with multiple psychiatric co-morbidities. Particularly in Japan, the incidence of mental disorders occurred in hikikomori was almost twice that of the age-matched population, and risk of mood disorders was six-times higher among the hikikomori [3]. There is nothing wrong for any individuals who choose to withdraw from a life that they feel is stressful, and even to some such lifestyle of being hikikomori may be an ideal one. However, healthcare professionals concern on the kind of lifestyle they are living with. Apart from social withdrawal, it has revealed that many hikikomori cases were having sedentary lifestyle, which may harm both mental and physical health [5,17]. Previous researches have been mainly focused on the psychological aspects of hikikomori, but rarely investigated into their physical health. Therefore, in the present study, with the aim to establish the first comprehensive health profile for hikikomori, a cross-sectional study was conducted to explore how well the social, mental and physical health aspects were of young people who were living in "hikikomori" lifestyle and to measure their lifestyle patterns. Secondarily, the health status parameters of hikikomori cases were compared with those of newly onset.

2. Materials and Methods

2.1. Target Participants

Hikikomori youths living in Hong Kong (HK) were recruited according to the inclusion criteria of: 1) HK residents of Chinese ethnicity; 2) Aged 13-34; 3) Not working or attending school; 4) Persistent withdrawal for >6 months; and 5) With a social network index (SNI) score of < 2. Whilst the following individuals were excluded: 1) Working in home-based offices; 2) Lived in an institution or hostel in the past 6 months; 3) Part-time students or self-studying; 4) Having chronic physical illnesses, severe injury, and/or disability; 5) With psychotic and associated symptoms as screened using the Psychotic Screening Module of the Structured Clinical Interview for DSM Disorders Axis I (SCID-I); or 6) Diagnosed medically with major emotional disorders. Participants who have fulfilled all the above criteria but exhibited persistent withdrawal for <6 months at recruitment were classified as "newly onset cases"; however, before data analysis all cases were confirmed the fulfillment of the 6-month withdrawal criterion as hikikomori cases.

2.2. Recruitment and Interview Procedures

Ethical approval (Reference: HSEARS20151126002) was obtained from the Human Subjects Ethics Committee of the HK Polytechnic University. Potential participants were initially invited to participate by their case social workers (already had a trustful relationship). Then, researcher (interviewer) was accompanied by the corresponding social worker to pay a home visit to a potential participant. Following introduction of the researcher by the social worker and the informed consent procedure, social worker would leave the place temporarily to allow the interview to take place. Psychotic status and eligibility were first assessed through a quick face-to-face interview using the screening questionnaire. Ineligible participants were excluded immediately to terminate the interview. Eligible participants were then proceeded with the physical measurements and followed by completing a set of self-administered questionnaires. The whole procedure took around 45-60 minutes to complete. A cash voucher was given to the participants at the end as an incentive. To avoid selection and information bias, the accuracy of the data regarding the eligibility was cross-checked against the case record from the social worker. All researchers were well trained, particularly a 20-hour training was provided for the semi-structured SCID-I with the use of the instrument training kit as specified by the developer. Inter-rater reliability was assessed prior to the data collection until satisfactory agreement was achieved among all data collectors.

Peer-reviewed version available at Int. J. Environ. Res. Public Health 2018, 15, 315; doi:10.3390/ijerph15020315

2.3. The Instrument and Measurements

The instrument used in this study adopted a set of established scales. The socio-demographics section assessed i) the eligibility of subject in terms of psychiatric status (by SCID-I), age, residential status, working or schooling status, and length of social withdrawal; and (ii) collected information about financial condition, smoking habits, usual daily activities pursued such as surfing the Internet, reading comics, and watching animation. The mental health section adopted i) the Chinese 14-item Perceived Stress Scale (PSS-14) for assessing the degree to which hikikomori individuals perceived their lives as stressful; ii) the Chinese Beck Depression Inventory-II (BDI-II); and iii) the Chinese State Anxiety Scale of State-Trait Anxiety Inventory (STAI-Y1) for assessing the trait state of anxiety. The lifestyle section mainly evaluated the degrees of distortion on way of living by using i) the Chinese Godin Leisure-Time Exercise Questionnaire (GLTEQ) to assess the frequency with which an individual engages in different levels of physical activities; ii) the Chinese Pittsburgh sleep quality index (PSQI) to measure sleep quality; iii) "How healthy is your diet? Questionnaire" [18] to measure the number of servings and frequency with which an individual eats certain types of food that the general population normally eats. The social health section assessed both the social and family supports by using i) the modified Berkman-Syme Social Network Index (SNI) to measure social connectedness, ii) the Chinese Interpersonal Support Evaluation List – Short version (ISEL) for assessing appraisal, belonging, tangible dimensions, and the relationship dimension of Chinese Family Environment Scale (CFES) to assess the three key subscales, namely cohesion, expressiveness, and conflict.

The Chinese SF-36 Physical Functioning Subscale (PF-10) was adopted for assessing the physical functioning. Anthropometric measurements including body weight, height, and waist and hip circumference were recorded and used for calculating the Body Mass Index (BMI) and waist-hip ratio. The widest possible head circumference was measured by using a non-stretchable tape. The length and width of ears were measured by using a caliper. The blood pressure (BP; systolic and diastolic values) and pulse rate were measured by using an automatic oscillometric blood pressure monitor (Microlife BP A200 AFIB, Switzerland). This device was also equipped with the atrial fibrillation (AFIB) detection to suggest the stroke risk. Blood pressure was measured twice each 5-10 minutes apart and the average value was taken. In case of the two BP readings had a discrepancy over 10%, a well-trained nursing student would use a mercury sphygmomanometer and stethoscope to measure the final BP values. Any positive AFIB indications were repeated the measure when participants had completed the questionnaire administration, and only recorded as positive if both measurements were positive and the participants were recommended to seek for medical help as soon as possible. Respiratory rate was taken by counting the number of breaths for one minute by counting how many times the chest rises.

Internal consistency reliability of the instrument was assessed with 78 youngsters aged 19-23. Cronbach's alpha vales were 0.80 for PSS-14, 0.88 for BDI-II, 0.91 for STAI-Y1, 0.82 for SF-26 (PF-10), 0.70 for exercise, 0.70 for PSQI, 0.73 for dietary, 0.77 for social connection, 0.74 for social support, and 0.71-0.77 for the three family relationship dimensions.

2.4. Data Processing and Analysis

Data collected was analyzed using IBM SPSS Statistics 22.0. All filled set of questionnaires were coded. Whereas privacy information that enables to recognize the identity of participant such as name, identity card number, and phone number were not entered into the SPSS data set, but input separately as an excel file encrypted with a password and stored in a separated computer. With regard to demographic data, frequency and percentage were computed for each of the binary or categorical variables (for example gender). Mean and standard deviation (SD) were computed for continuous variables, for example time spent on sleeping. The composite scores were computed for all components scales of the instrument according to the corresponding scoring schemes, and interpreted following the instrument manuals. Means and SD of the composite scores as well as the remaining outcome physical health variables (such as anthropometric and BP measures) were also

Peer-reviewed version available at Int. J. Environ. Res. Public Health 2018, 15, 315; doi:10.3390/ijerph15020315

computed and transformed into the reporting values if necessary. The variables were compared between subgroups of hikikomori cases and newly onset cases by using chi-squared test for those variables with two categories and students't-test for those continuous variables. Pearson's correlational analysis was performed to determine the association between the variables.

3. Results

3.1. Demographics and Living Lifestyle

From September 2016 to April 2017, a total of 172 hikikomori were initially screened by their case social workers for eligibility, and 104 participants (successful rate of 60.5%) were referred to participate and had completed the set of questionnaires and all anthropometric and physical measurements. Their demographic characteristics were summarized in Table 1 with mean age of 19.02 year-old (SD=3.62; ranged 13-31) at recruitment and a male-to-female ratio of 3:2. They had been living as hikikomori for 16.14 months (SD=20.16; ranged 3-72 months) who were divided half-and-half into the groups of newly onset cases (3-6 months) and hikikomori cases (>6 months). Prior to the data analysis, all newly onset cases were confirmed in follow-up for persistent withdrawal beyond 6 months. A vast majority of the cases (96%) was dependent on the family for housing and living. Older cases indicated to be more avoidant on direct communication with unfamiliar people ($p<0.05$) while they were more dependent on family's financial support ($p<0.05$).

Lifestyle patterns of the two subgroups were compared in Table 2. Overall, about half of the participants (45.2%) were living with a sedentary lifestyle in accordance with their Gobin weekly leisure activity scores, which was significantly ($p<0.01$) more common in the older cases. Participants performed 3 times light exercise and 1.5 times moderate exercise in an average week, but rarely performed exercise at strenuous level (Table 2). Participants slept almost 8 hours per day and spent most of their awake time staying at home and using electronic devices. They spent 1-3 hours on eating but the diets were relatively unhealthy with a "How healthy is your diet" score of 12.6 (SD=4.85) out of 33 (Table 2). In an average week, 91% of participants had consumed fast food at least once and 77% consumed different kinds of sweets. Over half consumed sugary drinks every day, particularly soda and caffeinated drinks were the most mentioned drinks consumed. Furthermore, 80% of the participants consumed one or less of vegetables and fruits serving per day while 83% consumed four types or less per month. Results also indicated that the majority (74%) slept poorly, with a mean Global PSQI score of 6.85 (SD=3.36). Lowest scores were rated in subjective sleep quality, sleep latency, and sleep disturbance.

3.2. The health profile

A vast majority of participants were indicated to be at good physical functioning with a SF-36 subscale score >80 (Table 3), but a significant proportion exhibited problems with body weight and blood pressure. Up to 70% of the participants exhibited the division of their body weight into two opposing extremes as either underweight or overweight/ obese. Underweight was dominated among the newly onset cases, specifically 46% was rated as "underweight" according to the BMI classification and 39% rated "below standard" according to the body fat classification (Table 3). In contrast, the older cases were significantly heavier ($p<0.001$) in weight and higher in other parameters including BMI ($p<0.01$), waist circumference ($p<0.001$) and waist-to-hip ratio ($p<0.01$). Overall, 38% of the older cases were classified as obese in accordance with body fat percentages while the majority were at the mildly obese level. Consistently, 48% of older cases were rated overweight or obese according to the BMI criteria, which was further broken down into 7.7% overweight, 21.2% pre-obese and 19.2% obese. No significant difference was observed between the two groups in other anthropometric variables (Table 3).

Peer-reviewed version available at Int. J. Environ. Res. Public Health 2018, 15, 315; doi:10.3390/ijerph15020315

192 **Table 1.** Demographic characteristics of hikikomori youths living in Hong Kong.

Variables		Total (N=104)	Newly onset cases (N=52)	Older cases (N=52)	χ2 *p*-value
		Number (Percentage)			
Gender	Male	62 (59.6)	29 (55.8)	33 (63.5)	0.424
	Female	42 (40.4)	23 (44.2)	19 (36.5)	
Age (yrs)	13-17	41 (39.4)	24 (46.2)	17 (32.7)	0.288
	18-24	54 (51.9)	25 (48.1)	29 (55.8)	
	25-34	9 (8.7)	3 (5.7)	6 (11.5)	
Mean±SD		19.02±3.62	18.42±3.59	19.62±3.5	0.127
Duration of being hikikomori (Mths), mean±SD		16.14±20.16	3.63±1.09	28.65±22.36	**<0.001**
Living	Alone	2 (1.9)	0 (0)	2 (3.8)	0.257
	With family	100 (96.2)	51 (98.1)	49 (94.2)	
	With relatives/friends	2 (1.9)	1 (1.9)	1 (1.9)	
Residential	Self-owned/self-rented	2 (1.9)	1 (1.9)	1 (1.9)	0.382
	Owned/rented by family/relatives/friends	102 (98.1)	51 (98.1)	51 (98.1)	
Financial source	Self	23 (22.1)	17 (32.7)	6 (11.5)	**0.024**
	Family/relatives	80 (76.9)	34 (65.4)	46 (88.5)	
	Refused to answer	1 (1)	1 (1.9)	0 (0)	
Avoiding direct or face-to-face communication		30 (28.8)	10 (19.2)	20 (38.5)	**0.030**

193

194

Peer-reviewed version available at Int. J. Environ. Res. Public Health 2018, 15, 315; doi:10.3390/ijerph15020315

Table 2. Lifestyle living with the hikikomori of Hong Kong.

Variables		Total (N=104)	Newly onset cases (N=52)	Older cases (N=52)	T-test *p*-value
		Mean±SD			
No. of hours staying at home		19.11±4.40	18.19±4.83	20.02±3.76	0.425
Daily activities at home (hrs)					
Sleeping		7.83±1.99	7.54±1.89	8.12±2.06	0.140
Using Computer		5.09±4.97	4.44±4.37	5.73±5.48	0.188
Using mobile phone/tablet		3.11±5.03	3.10±5.11	3.12±5.00	0.985
Eating		1.90±1.03	1.77±0.942	2.04±1.10	0.183
Reading comics/animation		0.95±2.38	1.00±2.94	0.90±1.68	0.838
Watching TV		0.90±1.13	0.73±1.07	1.08±1.17	0.118
Other readings		0.80±1.44	0.83±1.45	0.77±1.44	0.839
Other activities (not disclosing)		0.65±2.09	0.35±0.86	0.96±2.81	0.135
Idling/facing the wall		0.40±0.99	0.38±0.72	0.42±1.21	0.844
Sleeping quality					
Global PSQI score		6.85±3.36	6.94±3.27	6.75±3.48	0.772
Poor sleeper (PSQI >5), n (%)		77 (74.0)	41 (78.9)	36 (69.2)	0.263[#]
How healthy is your diet? (Max. score = 33)		12.57±4.85	12.73±4.51	12.40±5.20	0.733
Physical activity					
Weekly leisure activity score		24.87±31.81	29.69±35.58	20.06±27.02	0.123
Level, n (%)	Active	38 (36.5)	23 (44.2)	15 (28.9)	0.002[#]
	Moderately active	19 (18.3)	14 (26.9)	5 (9.6)	
	Insufficiently active/ Sedentary	47 (45.2)	15 (28.9)	32 (61.5)	
Smoking, n (%)	Never	81 (77.9)	39 (75)	42 (80.8)	0.669[#]
	Quitted	10 (9.6)	5 (9.6)	5 (9.6)	
	Current smoker	13 (12.5)	8 (15.4)	5 (9.6)	

Note: [#]Determined by using chi-squared test.

According to the JNC7's classification, 16 (15.4%) and 33 (31.7%) participants were found to have hypertension and prehypertension, respectively with mean SBP/DBP of 141.31/90.69 (SD=10.29/5.40) mmHg and 125.85/79.09 (SD=8.92/5.28) mmHg. Significantly higher systolic and diastolic values were shown in the older cases, whereas the incidence of hypertension and prehypertension were 3-fold and 1.5-fold of the newly onset cases, respectively. Half of the hypertensive cases were the isolated diastolic type while 31% were the isolated systolic type (80% older cases) and the 19% were systolic-diastolic type (all older cases). Only one stage 2 hypertensive case was identified who had been living as hikikomori for 24 months. Age was the only demographic characteristic that correlated with the SBP ($r=0.27$; $p<0.01$) and DBP ($r=0.34$; $p<0.01$) levels. However, positive and significant correlations ($r=0.28$-0.63; $p<0.01$) were observed between the BP levels of participants and all obesity index parameters measured (Table 3). None of the hypertensive cases identified in this study was found to have a positive AFIB.

Peer-reviewed version available at Int. J. Environ. Res. Public Health 2018, 15, 315; doi:10.3390/ijerph15020315

212 **Table 3.** Anthropometric, physical functioning and physical health measurements in the hikikomori.

Variables	Overall (N=104)	Newly onset cases (N=52)	Older cases (N=52)	T-test *p*-values
		Mean±SD		
Anthropometrics				
Head circumference (cm)	55.3±4.0	54.6±2.7	55.9±4.9	0.100
Ear dimension, Length (mm)	57.9±6.4	56.8±6.9	59.0±5.8	0.076
Ear dimension, Width (mm)	27.1±2.9	26.8±2.8	27.3±3.0	0.395
Height (cm)	164.0±9.9	162.4±10.4	165.5±9.2	0.101
Weight (Kg)	60.6±19.8	53.9±13.9	67.4±22.6	**<0.001**
BMI (Kg/m^2)	22.3±6.9	20.1±4.7	24.4±8.0	**0.001**
BMI classification, n(%)				
Underweight	39 (37.5)	24 (46.2)	15 (28.8)	**0.008**#
Normal	30 (28.8)	18 (34.6)	12 (23.1)	
Overweight/ Obese	35 (33.7)	10 (19.2)	25 (48.1)	
Body fat (%)	21.1±9.3	18.8±8.3	23.3±9.8	**0.014**
Body fat classification, n(%)				
Below standard	32 (30.8)	20 (38.5)	12 (23.1)	**0.002**#
Standard	47 (45.2)	27 (51.9)	20 (38.5)	
Obese	25 (24.0)	5 (18.3)	20 (38.4)	
Waist circumference (cm)	77.6±16.9	71.1±11.9	84.2±18.7	**<0.001**
Non-ideal waist circumference, n(%)	28 (26.9)	5 (9.6)	23 (44.2)	**<0.001**#
Waist-to-hip ratio	0.82±0.09	0.80±0.74	0.85±0.10	**0.004**
Physical functioning (SF-36)	83.99±19.01	86.54±17.70	81.44±20.08	0.173
Physical health measurements				
SBP (mmHg)	118.0±15.6	113.7±13.1	122.4±16.8	**0.004**
DBP (mmHg)	75.0±10.3	71.7±9.7	78.4±9.8	**0.001**
Pulse pressure (mmHg)	42.8±10.0	42.0±9.0	43.6±10.9	0.435
Pulse rate (per minute)	84.9±14.6	82.5±11.9	87.3±16.6	0.096
Respiratory rate (per minute)	17.7±1.2	17.5±1.1	18.0±1.3	0.060
AFIB, n(%)	0	0	0	-
BP classification, n(%)				
Normal	54 (51.9)	35 (67.3)	20 (38.5)	**0.020**#
Prehypertension	33 (31.7)	13 (25.0)	20 (38.5)	
hypertension	16 (15.4)	4 (7.7)	12 (23.0)	

213 Note: #Determined by using chi-squared test.

214 Regarding the mental health, participants demonstrated moderate levels of perceived stress
215 (scored 30.04±8.01) and state anxiety (scored 44.22±12.17) but depression at borderline clinical level
216 (scored 17.17±11.49) (Table 4). Particularly, 37.4% of the participants had depression at moderate level
217 and above. However, no statistical significance was observed between the two subgroups for all three
218 negative emotional states (Table 4). Socially, participants demonstrated a remarkable degree of
219 asocial behavior, as measured by SNI and ISEL. The older cases were shown to be more socially
220 isolated than those newly onsets, although statistically non-significant (Table 4). Also statically non-
221 significant, the older cases were relatively trended to be less expressive and less conflict towards
222 family, but rated slightly higher on family cohesion (Table 4).

223

Peer-reviewed version available at Int. J. Environ. Res. Public Health 2018, 15, 315; doi:10.3390/ijerph15020315

Table 4. Mental health, social and family supports measure in hikikomori.

Variables	Total (N=104)	Newly onset cases (N=52)	Older cases (N=52)	T-test *p*-value
		Mean±SD		
Mental Health				
PSS score	30.04±8.01	30.08±8.55	30.00±7.51	0.961
S-Anxiety score	44.22±12.17	44.73±11.55	43.71±12.84	0.671
Beck Depression score	17.17±11.49	16.90±11.49	17.44±11.59	0.812
Social support				
SNI score	0.58±0.50	0.65±0.48	0.50±0.51	0.115
ISEL score	24.60±6.30	25.40±6.31	23.79±6.24	0.192
Family support (CFES)				
Cohesion score	5.61±2.89	5.37±3.01	5.85±2.77	0.399
Expressiveness score	4.60±2.20	4.71±2.39	4.48±2.01	0.595
Conflict score	3.79±2.37	4.02±2.65	3.56±2.06	0.323

4. Discussion

To our best knowledge, this is the first study conducted to measure the physical health of hikikomori together with other parameters on psychological and social health. Hong Kong youths living with a "Hikikomori" lifestyle were found to have a high incidence of hypertension and prehypertension, which were believed to be correlated with the weight gains during the course of hermetic behavior. Results suggested that the length of hikikomori duration was associated with a shift of body weight from underweight to overweight and obesity, which has also signified the problem of elevated blood pressure. Such physical manifestations seemed to be related to the sedentary lifestyle that was commonly shared among the hikikomori cases, in addition to their unhealthy dietary habits and distorted sleep patterns.

Participants of this study shared similar asocial behavior with a few previous studies conducted in other places [1,4,5], which were also co-morbid with negative emotional states more commonly with depression, anxiety and distress. This study observed an overall high prevalence of 15.4% for hypertension, which was comparable with the 12.8% age-specific prevalence for young people aged 15-34 as reported by the HK Population Health Survey in 2004 [19]. Such prevalence was even slightly higher than the 12.6% local prevalence including all diagnosed hypertensive cases in adults as reported by the Census and Statistics Department of HK in 2014 [20], but much lower than the adjusted prevalence of 32% after including hidden hypertensive cases within the community as reported in a recent local large-scale cohort study [21]. However, more concerns were caused by another 31.7% of hikikomori cases who were identified as "prehypertension". Given that pre-hypertension was rarely investigated amongst the younger populations and no local age-matched prevalence was available for comparison, the current prevalence was not much below the 42.7% prevalence reported amongst the older adults at age ≥35 [22]. The risks of transiting prehypertension into hypertension and other cardiovascular complications and metabolic disorders have been well documented [18,22-24]. Looking more-in-depth into the hypertensive types, hypertension occurring at younger ages are more commonly belonging to the isolated diastolic type, because an increase of systolic BP is often caused by changes of arterial stiffness that should be more frequently happened with aging but unexpected at younger ages [18,25]. Besides being a primary target for antihypertensive therapies, systolic BP also carries predictive value for cardiovascular risk [26]. Systolic hypertension was known to have higher odds for cardiovascular diseases and stroke [27]. Despite no positive AFIB was discovered in any of the hypertensive cases in this study which excluding quivering or irregular heartbeat to suggest no immediate risk of stroke [28], the high

Peer-reviewed version available at Int. J. Environ. Res. Public Health 2018, 15, 315; doi:10.3390/ijerph15020315

prevalence of prehypertension and involvement of systolic BP elevation in half of the cases caused much worry.

In fact, both hypertension and prehypertension were significantly more prevalent in older cases who have been engaged longer as hikikomori. The daily activities of hikikomori cases identified herein were consistent with the previous reported top solitary activities pursued by young socially withdrawn people such as surfing the Internet, chatting on-line with strangers, and sitting in a corner, all of which were sedentary in nature [5,29,30]. Sedentary lifestyle itself is already a known risk factor for hypertension and other cardiovascular complications [31-34], whereas sedentary working pattern was even proposed as a strong predictive factor for developing into hypertension among individuals who were pre-hypertensive [22]. Furthermore, in this study, BP levels of hikikomori cases were positively correlated with various adiposity measures, whereas many participants were engaged in sedentary lifestyle that characterized by insufficient physical activities and snacking on unhealthy foods. BMI and waist circumference were well accepted risk factors for predicting the occurrence of hypertension in young people [35,36]. Participants of this study consumed sweet snacks and sugary drinks frequently were also highly engaged in fast food diets often high in fat, low in fiber and high in sodium. Excessive energy intake and insufficient physical activities could be a major cause of weight gains by time, which eventually leads to obesity [37,38]. Accumulation of fat and cholesterols, especially triglycerides causes narrowing of blood vessels and atherosclerosis may contribute to elevated BP [39,40]. High salt intake is not only a well-known cause of BP elevation, but it is also associated with obesity independent of energy intake [37]. Altogether, the physical traits of hikikomori with raised BP and obesity were at least partially linked with their distorted lifestyle. Furthermore, the poor sleeping quality of current participants was consistent with previous report that hikikomori tended to sleep at extreme late night hours or during the day [41]. Very frequent and prolonged use of computer and electronic devices at home as the top activities amongst the hikikomori cases could be associated with poor sleeping quality, which was coincided with the strong association between sleep quality and daytime function with the use of technologies [42,43]. Irregular sleep-wake pattern would interfere with the light–dark cycle and the circadian clock in the human body, which could have deleterious effects on different aspects of health and quality of life [44]. Clinical significance of human circadian rhythms was reviewed [45], which has highlighted the negative impacts of disrupted sleeping cycle on cardiovascular regulation associated with BP levels. Another study discussed how irregular sleep-wake rhythm of hikikomori could be associated with physical problems such as headaches, neck, back, or muscle pain, and gastrointestinal problems [41]. However, many of such physical parameters have not been measured in the current study, and is deemed to be further investigated.

This study has several strengths. First, this is the first of its kind to explore this hidden population by including empirical physical measurements. The physical assessments were not only beneficial in objective measurements to strengthen the evidence, but it was also found to be important to arise the interest and awareness of participants to concern more of their health or at least to adopt a less “hikikomori-type” lifestyle. Social workers also found such kind of physical measurements could help to engage their clients better and create more dialog with their clients. Second, samples were recruited from multiple centers that were operated by different social service teams. This approach covers well HK’s residential areas, which allows a representative sampling and reducing selective and geographical bias. Third, during the home visits, interviewers were first introduced by the case social workers who have already established a trustful relationship with the participants. This procedure was found to be effective in enhancing the successful rate of subject recruitment, which is particularly important for those were originally asocial. It avoided miscommunications and misunderstanding, which resulted in a very quick buildup of bonding between the participant and interview to facilitate the interview process and physical assessment. Fourth, all physical assessments were conducted by well-trained registered nurses or nursing students who have sufficient knowledge to ensure accurate measurements, and at a more appropriate position to handle health needs or enquiries that may be brought up by the participants.

There are also several limitations in this study, owning to the hidden nature of the target participants who are basically unreachable, subject recruitment is considered as the most difficult part of the study. It caused the small sample size as a major limitation. However, the sample size was sufficiently enough to be divided evenly into two subgroups, which was important to achieve statistical significance when certain measured variables were compared. Furthermore, although participants of this study were recruited from multiple centers, sampling through a single agent i.e. social work is also considered as a major limitation because many hidden cases still could not be reached. It is suggested that other agencies such as secondary schools, student residency of universities, other family-based services, medical units, and relevant online forums can also be approached for sampling in the future studies.

5. Conclusions

Hikikomori lifestyle was largely sedentary in nature that could be a risk behavior that may harm the younger generation physically by promoting obesity and increase the chance of hypertension and possibly other chronic illnesses. The associated health impacts of hikikomori behavior may cause severe socioeconomic burden to the healthcare service. A longitudinal study is undergoing to follow-up on this high risk group on measuring the changes in various health aspects.

Acknowledgments: This project was financially supported by the Health and Medical Research Fund (Project No. 13144071) from the Food and Health Bureau of Hong Kong.

Author Contributions: The research team designed the study and share equal contributions. John W.M. Yuen is the project leader who has supervised the project and finalized the manuscript. Yoyo K.Y. Yan is the project manager who has carried out the logistic of data collection and written the first draft of the manuscript. Victor C.W. Wong and K.W. So coordinated with all collaborative social service team to enable the sampling. The epidemiologist Wilson W.S. Tam contributed in the finalization of the data analysis and presentation of the results. W.T. Chien mainly responded in the constructs and validation of the instruments for measuring different variables. All authors have read the manuscripts and agreed with the contents.

Conflicts of Interest: The authors declare that they have no conflict of interest.

References

1. Kato, T. A.; Tateno, M.; Shinfuku, N.; Fujisawa, D.; Teo, A. R.; Sartorius, N.; Akiyama, T.; Ishida, T.; Choi, T. Y.; Balhara, Y. P.; Matsumoto, R.; Umene-Nakano, W.; Fujimura, Y.; Wand, A.; Chang, J. P.; Chang, R. Y.; Shadloo, B.; Ahmed, H. U.; Lerthattasilp, T.; Kanba, S. Does the 'hikikomori' syndrome of social withdrawal exist outside Japan? A preliminary international investigation. *Soc. Psychiatry Psychiatr. Epidemiol.* **2012,** *47* (7), 1061-1075, doi:10.1007/s00127-011-0411-7.
2. Watts, J. Public health experts concerned about "hikikomori". *Lancet* **2002,** *359* (9312), 1131, doi:10.1016/S0140-6736(02)08186-2.
3. Koyama, A.; Miyake, Y.; Kawakami, N.; Tsuchiya, M.; Tachimori, H.; Takeshima, T. Lifetime prevalence, psychiatric comorbidity and demographic correlates of "hikikomori" in a community population in Japan. *Psychiatry Res.* **2010,** *176* (1), 69-74, doi:10.1016/j.psychres.2008.10.019.
4. Wong, P. W.; Li, T. M.; Chan, M.; Law, Y. W.; Chau, M.; Cheng, C.; Fu, K. W.; Bacon-Shone, J.; Yip, P. S. The prevalence and correlates of severe social withdrawal (hikikomori) in Hong Kong: A cross-sectional telephone-based survey study. *Int. J Soc. Psychiatry* **2015,** *61* (4), 330-342, doi:10.1177/0020764014543711.
5. Wong, V.; Ying, W. Social Withdrawal of Young People in Hong Kong: A Social Exclusion Perspective. *Hong Kong J. Social Work* **2006,** *40* (01n02), 61-91, doi:10.1142/S0219246206000064.
6. Wong, V. Youth locked in time and space? Defining features of social withdrawal and practice implications. *Journal of Social Work Practice* **2009,** *23* (3), 337-352, doi:10.1080/02650530903102692.
7. Chauliac, N.; Couillet, A.; Faivre, S.; Brochard, N.; Terra, J. L. Characteristics of socially withdrawn youth in France: A retrospective study. *Int. J Soc. Psychiatry* **2017,** *63* (4), 339-344, doi:10.1177/0020764017704474.

8. Malagon-Amor, A.; Corcoles-Martinez, D.; Martin-Lopez, L. M.; Perez-Sola, V. Hikikomori in Spain: A descriptive study. *Int. J Soc. Psychiatry* **2015,** *61* (5), 475-483, doi:10.1177/0020764014553003.
9. Ranieri, F. When social withdrawal in adolescence becomes extreme: the "hikikomori" phenomenon in Italy. *Psychiatria I Psychologia Kliniczna-Journal of Psychiatry and Clinical Psychology* **2015,** *15* (3), 148-151, doi:10.15557/PiPK.2015.0023.
10. Kondo, N.; Sakai, M.; Kuroda, Y.; Kiyota, Y.; Kitabata, Y.; Kurosawa, M. General condition of hikikomori (prolonged social withdrawal) in Japan: psychiatric diagnosis and outcome in mental health welfare centres. *Int. J Soc. Psychiatry* **2013,** *59* (1), 79-86, doi:10.1177/0020764011423611.
11. Furuhashi, Y. P-600 - Comparision between teen-onset hikikomori and adlut-onset hikikomori in Japan. *European Psychiatry* **2012,** *27*, 1, doi:10.1016/S0924-9338(12)74767-3.
12. Lee, Y. S.; Lee, J. Y.; Choi, T. Y.; Choi, J. T. Home visitation program for detecting, evaluating and treating socially withdrawn youth in Korea. *Psychiatry Clin. Neurosci.* **2013,** *67* (4), 193-202, doi:10.1111/pcn.12043.
13. Teo, A. R. A new form of social withdrawal in Japan: a review of hikikomori. *Int. J Soc. Psychiatry* **2010,** *56* (2), 178-185, doi:10.1177/0020764008100629.
14. Borovoy, A. Japan's hidden youths: mainstreaming the emotionally distressed in Japan. *Cult. Med. Psychiatry* **2008,** *32* (4), 552-576, doi:10.1007/s11013-008-9106-2.
15. Nagata, T.; Yamada, H.; Teo, A. R.; Yoshimura, C.; Nakajima, T.; van, V., I Comorbid social withdrawal (hikikomori) in outpatients with social anxiety disorder: clinical characteristics and treatment response in a case series. *Int. J Soc. Psychiatry* **2013,** *59* (1), 73-78, doi:10.1177/0020764011423184.
16. Yong, R. Exploring Hikikomori - A Mixed Methods Qualitative Approach. *International Journal of Behavioral Medicine* **2010,** *17*, 81-82, doi:10.5353/th_b4171214.
17. Teychenne, M.; Ball, K.; Salmon, J. Sedentary Behavior and Depression Among Adults: A Review. *International Journal of Behavioral Medicine* **2010,** *17* (4), 246-254, doi:10.1007/s12529-010-9075-z.
18. Franklin, S. S.; Pio, J. R.; Wong, N. D.; Larson, M. G.; Eric P.; Vasan, R. S.; Levy, D. Predictors of New-Onset Diastolic and Systolic Hypertension. *Circulation* **2005,** *111* (9), 1121-1127, doi:10.1161/01.CIR.0000157159.39889.EC.
19. Department of Health. Hong Kong Reference Framework for Hypertension Care for Adults in Primary Care Settings. Available online: http://www.pco.gov.hk/english/resource/files/RF_HT_full.pdf (accessed on 10-28-2017).
20. Centre for Health Protection. Hypertension. Available online: http://www.chp.gov.hk/en/healthtopics/content/25/35390.html (accessed on 10-28-2017).
21. Family Council. Family Project Cohort Study. Available online: http://www.familycouncil.gov.hk/english/home/files/FC_Paper_2_2015_HKJC_Family%20Cohort%20Study%20v13.pdf (accessed on 10-28-2017).
22. Sit, J. W. H.; Sijian, L.; Wong, E. M. Y.; Yanling, Z.; Ziping, W.; Jianqiang, J.; Yanling, C.; Wong, T. K. S. Prevalence and Risk Factors Associated With Prehypertension: Identification of Foci for Primary Prevention of Hypertension. *Journal of Cardiovascular Nursing* **2010,** *25* (6), 461-469, doi:10.1097/JCN.0b013e3181dcb551.
23. Cornelissen, V.; Fagard, H. Effects of Endurance Training on Blood Pressure, Blood Pressure-Regulating Mechanisms, and Cardiovascular Risk Factors. *Hypertension* **2005,** *46*, 667-675, doi:10.1161/01.HYP.0000184225.05629.51.
24. Fukuhara, M.; Arima, H.; Ninomiya, T.; Hata, J.; Yonemoto, K.; Doi, Y.; Hirakawa, Y.; Matsumura, K.; Kitazono, T.; Kiyohara, Y. Impact of lower range of prehypertension on cardiovascular events in a general population: The Hisayama Study. *Journal of Hypertension* **2012,** *30* (5), 893-900, doi:10.1097/HJH.0b013e328351d380.

25. Grebla, R. C.; Rodriguez, C. J.; Borrell, L. N.; Pickering, T. G. Prevalence and determinants of isolated systolic hypertension among young adults: the 1999–2004 US National Health And Nutrition Examination Survey. *Journal of Hypertension* **2010,** *28* (1), 15-23, doi:10.1097/HJH.0b013e328331b7ff.
26. Arima, H.; Murakami, Y.; Hing Lam, T.; Chang Kim, H.; Ueshima, H.; Woo, J.; Suh, I.; Fang, X.; Woodward, M. Effects of Prehypertension and Hypertension Subtype on Cardiovascular Disease in the Asia-Pacific Region. *Hypertension* **2012,** *70* (6), doi:10.1161/HYPERTENSIONAHA.111.187252.
27. Strandberg, T. E.; Pitkala, K. What is the most important component of blood pressure: systolic, diastolic or pulse pressure? *Current Opinion in Nephrology and Hypertension* **2003,** *12* (3), 293-297, doi:10.1097/00041552-200305000-00011.
28. Kamel, H.; Okin, P. M.; Elkind, M. S. V.; Iadecola, C. Atrial Fibrillation and Mechanisms of Stroke. *Stroke* **2016,** *47* (3), 895-900, doi:10.1161/STROKEAHA.115.012004.
29. Li, T. M.; Wong, P. W. Youth social withdrawal behavior (hikikomori): A systematic review of qualitative and quantitative studies. *Aust. N. Z. J Psychiatry* **2015,** *49* (7), 595-609, doi:10.1177/0004867415581179.
30. Nardi, B.; Francesconi, G.; Catena Dell'Osso, M.; Bellantuono, C. Adolescent depression: Clinical features and therapeutic strategies. *Eur Rev Med Pharmacol Sci* **2013,** *17* (11), 1546-1551.
31. Barnes, A. S. Obesity and Sedentary Lifestyles: Risk for Cardiovascular Disease in Women. *Tex Heart Inst J* **2012,** *39* (2), 224-227.
32. Lakka, T. A.; Bouchard, C. Physical Activity, Obesity and Cardiovascular Diseases. In *Atherosclerosis: Diet and Drugs*, von Eckardstein, A., Ed.; Springer: Berlin, Heidelberg, Germany, 2005; Vol. 170, pp 137-163.
33. Manson, J. E.; Skerrett, P. J.; Greenland, P.; VanItallie, T. B. The escalating pandemics of obesity and sedentary lifestyle: A call to action for clinicians. *Archives of Internal Medicine* **2004,** *164* (3), 249-258, doi:10.1001/archinte.164.3.249.
34. Tremblay, M. S.; Colley, R. C.; Saunders, T. J.; Healy, G. N.; Owen, N. Physiological and health implications of a sedentary lifestyle. *Appl. Physiol. Nutr. Metab.* **2010,** *35* (6), 725-740, doi:10.1139/H10-079.
35. Drukteinis, J. S.; Roman, M. J.; Fabsitz, R. R.; Lee, E. T.; Best, L. G.; Russell, M.; Devereux, R. B. Cardiac and Systemic Hemodynamic Characteristics of Hypertension and Prehypertension in Adolescents and Young Adults. *Circulation* **2007,** *115* (2), 221-227, doi:10.1161/CIRCULATIONAHA.106.668921.
36. Leung, L. C. K.; Sung, R. Y. T.; So, H. K.; Wong, S. N.; Lee, K. W.; Lee, K. P.; Yam, M. C.; Li, S. P. S.; Yuen, S. F.; Chim, S.; Chan, K. K.; Luk, D. Prevalence and risk factors for hypertension in Hong Kong Chinese adolescents: waist circumference predicts hypertension, exercise decreases risk. *Arch Dis Child* **2011,** *96* (9), 804-809, doi:10.1136/adc.2010.202770.
37. Ma, Y.; He, J.; MacGregor, A. High Salt Intake: Independent Risk Factor for Obesity? *Hypertension* **2015,** *66* (4), 843-849, doi:10.1161/HYPERTENSIONAHA.115.05948.
38. Wong, J.; Ho, S. Y.; Lai, M. K.; Leung, M.; Stewart, S.; Lam, H. Overweight, obesity, weight-related concerns and behaviours in Hong Kong Chinese children and adolescents. *Acta Paediatrica* **2005,** *94* (5), 595-601, doi:10.1111/j.1651-2227.2005.tb01945.x.
39. Dzau, J. Atherosclerosis and hypertension: Mechanisms and interrelationships. *Journal of Cardiovascular Pharmacology* **1990,** *15*, S59-S64, doi:10.1097/00005344-199000005-00009.
40. Kodama, S.; Tanaka, S.; Heianza, Y.; Fujihara, K.; Horikawa, C.; Shimano, H.; Saito, K.; Yamada, N.; Ohashi, Y.; Sone, H. Association Between Physical Activity and Risk of All-Cause Mortality and Cardiovascular Disease in Patients With Diabetes. *Diabetes Care* **2013,** *36* (2), 471-479, doi:10.2337/dc12-0783.
41. Takasu, N. N.; Toichi, M.; Nakamura, W. Importance of regular lifestyle with daytime bright light exposure on circadian rhythm sleepГÇôwake disorders in pervasive developmental disorders. *Japanese Dental Science Review* **2011,** *47* (2), 141-149, doi:10.1016/j.jdsr.2011.04.001.

42. Calamaro, C. J.; Mason, T. B. A.; Ratcliffe, S. J. Adolescents Living the 24/7 Lifestyle: Effects of Caffeine and Technology on Sleep Duration and Daytime Functioning. *Pediatrics* **2009,** *123* (6), e1005-e1010, doi:10.1542/peds.2008-3641.

43. Kwisook, C.; Hyunsook, S.; Myunghee, P.; Jinkyu, H.; Kitai, K.; Byungkoo, L.; Hyesun, G. Internet overuse and excessive daytime sleepiness in adolescents. *Psychiatry & Clinical Neurosciences* **2009,** *63* (4), 455-462, doi:10.1111/j.1440-1819.2009.01925.x.

44. Paiva, T.; Gaspar, T.; Matos, M. G. Sleep deprivation in adolescents: correlations with health complaints and health-related quality of life. *Sleep Medicine* **2015,** *16* (4), 521-527, doi:10.1016/j.sleep.2014.10.010.

45. Klerman, E. B. Clinical Aspects of Human Circadian Rhythms. *J Biol Rhythms* **2005,** *20* (4), 375-386, doi:10.1177/0748730405278353.