

A Community Study of Uro-Psycho-Physical Changes in Young Adults Using Ketamine.

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Executive Summary

This study aims to identify the relative risk of dosage, frequency and duration of ketamine abuse for changes in body system functions and the extensiveness of damage caused in community young adults. From January 2011 to December 2012, 18 outreach mega-clinics were established at specific community centres. Two hundred and thirty teens attended the clinic for assessment. We have set up clinics in North District, Tai Po, Kwai Chung and Tsuen Wan. A total of 230 ketamine abusers were recruited into this research project

The mean age of starting drug abuse is 15.1years. The mean duration of ketamine abuse is 55.8months. 79.5% participants have abused ketamine for over 4 years. 60.1% abuse more than 5 times per week. 50% consumed alcohol while taking drug. Use of multiple drugs was reported by 68.3% (n=157) of the ketamine users, with the most common additional drugs being cocaine (48.9%), methamphetamine (26.1%), nimetazepam (15.5%) and cannabis (14.3%). Only 37.4% of them admitted themselves as dependent to the substance use.

This study identified the relative risk of dosage, frequency and duration of ketamine abuse for changes in body system functions and the extensiveness of damage caused in community young adults. The frequency of taking ketamine was inversely correlated with BMI. The dosage of ketamine use was correlated with BMI. 29.5% of abusers are underweight. Female is more likely to be underweight than male in this population. For male abusers with ketamine abuse frequency more than 2 times per week, the risk of BMI below average is 2.5 times of those who abuse less. For those with ketamine abuse more than 5 years, the risk of poor lung function is significantly higher than those who abuse less.

Among 52 participants in fine hand coordination test, 40.4% failed. The failure rate of those with ketamine abuse for more than 5 years is 7 times to those who abuse less.

76 participants were assessed on perceptual motor and memory (visual and verbal) aspects. Results indicated that memory was more prominently affected in this group of clients mainly abusing Ketamine. 24% of those also had impairment in

both perceptual and memory aspects. These clients might anticipate more problems in coping with daily living and work tasks.

The frequency of taking ketamine was associated with “Pelvic Pain, Urgency, Frequency” (PUF) symptoms score, bother score and total score. 47.8% of subjects suffered from overactive bladder symptom. Increase one day per week of ketamine use would increase 0.521 times probability of having overactive bladder symptom. Duration of ketamine use was inversely correlated with max flow rate. Frequency of taking ketamine was inversely correlated with max flow rate. Frequency of taking ketamine was inversely correlated with voided volume.

Out of 216 subjects with ultrasound performed, we picked up 14 bilateral hydronephrosis, 23 right hydronephrosis and nil left hydronephrosis. The duration of ketamine use was significantly correlated with having hydronephrosis. It indicated that increase in 1 year ketamine use would increase 0.977 times probability of having hydronephrosis. The dosage of ketamine use was significantly correlated with having hydronephrosis. It indicated that increase in 1 gram ketamine use would increase 0.579 times probability of having hydronephrosis.

The frequency of taking ketamine was significantly associated with higher Beck Depression Inventory (BDI) total score. The duration of ketamine use was significantly correlated with higher Hospital Anxiety and Depression Scale (HADS) total score. 58 subjects (48.3%) had reported experiencing one or more types of childhood adversities prior to age of 16. The reported adversity items included physical abuse, parental divorced/separation, parental substance use, parental mental disorder and sexual abuse.

There were 41 cases (18%) referred to Urology clinic after UROK outreach assessment. 34 cases (15%) were referred to Substance abuse clinic for management of significant psychiatric symptoms.

A press conference was held 25.8.2011 to release the results from the pilot study of this research. The preliminary outcomes of this research were presented on 11.11.2012 to peer doctors in the annual scientific meeting of Hong Kong Urological Association. The pilot study was published in Journal of Urology (an international peer-review journal). Education DVD on the services for psychotropic substances abusers is designed and produced.

Objectives

This study aims to identify the relative risk of dosage, frequency and duration of ketamine abuse for changes in body system functions and the extensiveness of damage caused in community young adults.

The Beat Drugs Fund Association, the Security Bureau, Hong Kong Government has approved a research grant of \$ 1,592,900 HKD on 8th September 2010 for funding “A Community Study of Uro-Psycho-Physical Changes in Young Adults Using Ketamine”. The study is performed by UROK (You are OK) outreach team in collaboration with non-government organizations (NGOs). The service provided a comprehensive one stop body screening for the adverse effects of ketamine abuse.

This team consisted of urologists, psychiatrists, nurses, physiotherapists, occupational therapists and health care assistants from North District Hospital, Alice Ho Miu Ling Nethersole Hospital and Prince of Wales Hospital, is established at specific youth community centres and subjects known to NGOs social workers who had a history of ketamine use are invited to participate in the assessment. The dosage, frequency, duration and onset of symptoms are surveyed. The urinary bladder function is evaluated using the Pelvic Pain Urgency and Frequency questionnaire (PUF), Overactive Bladder Symptom Score questionnaire (OABSS), uroflowmetry and portable ultrasonography. Other tests included a physical examination, psychiatric assessment of depression / anxiety score, fitness activities, motor and cognitive evaluation. Toxicology Point of Care Device (POCT) is used to verify the type of drug used.

From January 2011 to December 2012, 18 outreach mega-clinics were established at specific community centres. Two hundred and thirty teens attended the clinic for assessment. We have set up clinics in North District, Tai Po, Kwai Chung and Tsuen Wan. One clinic was cancelled due to bad weather condition.

We set up mobile clinics



In each mega-clinic, there are six assessment stations namely body mass index (BMI) & peak flow rate (PFR), physical fitness, cognitive function, urology, urology nursing, and psychiatry.



UROK team members at community hall



Hall view



Reception area



Body mass index & peak flow rate station



Physical fitness station



Cognitive station



Urology station



Urology nursing station





Psychiatry station



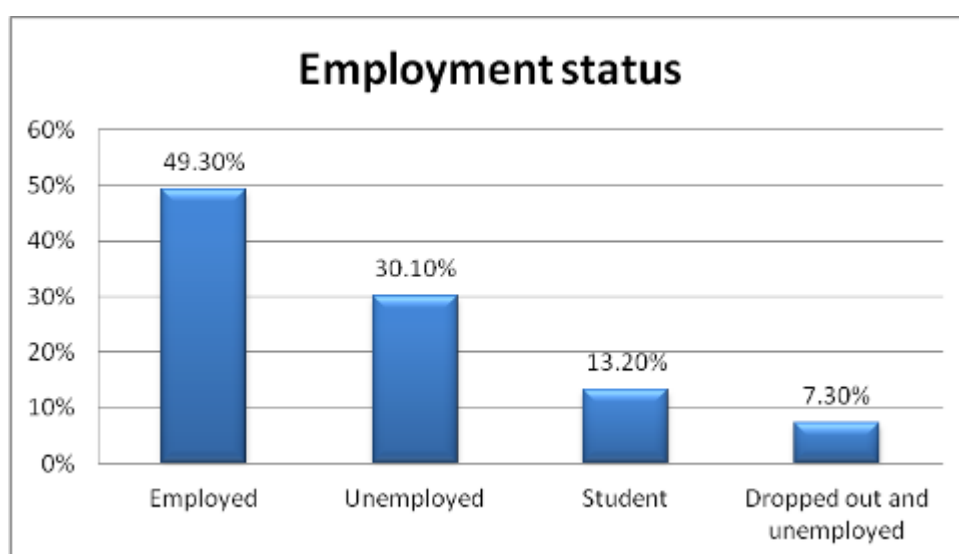
Clinical data obtained

This is a screening study on the adverse effect of ketamine on body functions. This research protocol is approved by Joint Chinese University of Hong Kong – New Territories Ease Cluster (CUHK-NTEC) Clinical Research Ethics Committee. All information given to subjects as part of informed consent is in accordance with generally accepted international practice. The study is performed by UROK team. Written consent to the study is obtained before the assessment.

1. Comprehensive history of family background and substance abuse record of past 6 months
2. Body mass index; Peak flow rate
3. Step Test; Shuttle Run Test; Hexagon Test and Balance Beam Test. (Appendix)
4. Cognitive and fine motor function assessment
5. Pelvic pain, urgency and frequency questionnaire (PUF); overactive bladder symptoms score questionnaire (OABSS); ultrasound measure of degree of hydronephrosis and bladder wall thickness; urine toxicology test; uroflow rate; and post void bladder scan
6. Beck Depression Inventory (BDI); the anxiety subscale of the Hospital Anxiety and Depression Scale (HADS-A); Structured Clinical Interview for DSM-IV Axis I Disorders;

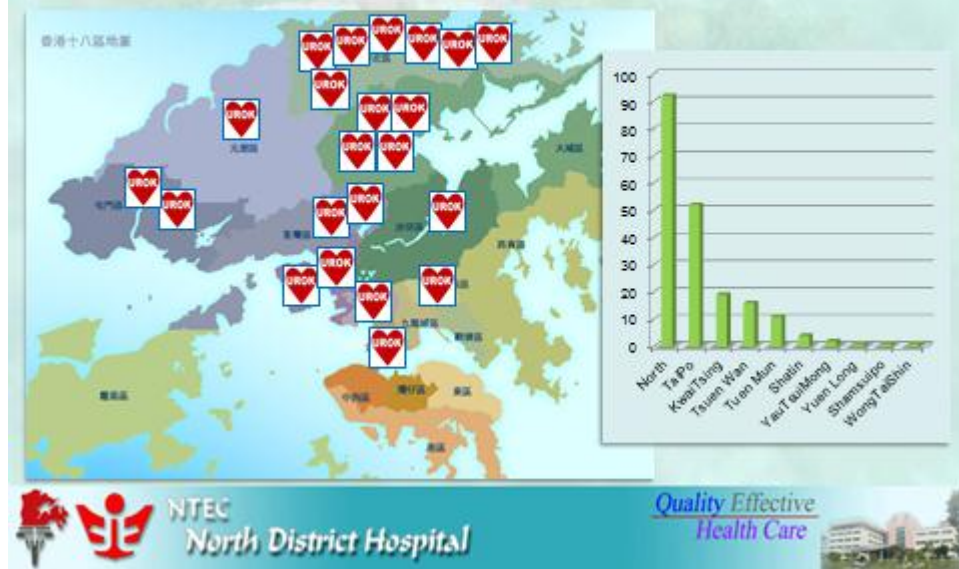
Results

230 subjects with lifetime use of ketamine, aged 14 to 42 years (mean = 20.58 years, SD=4.411 years) were recruited for this study. 162 (70.7%) were males and 67 (29.3%) were females. Among them, 49.3% (n= 108) were employed, 30.1% (n= 66) were unemployed, 13.2% (n= 29) were students and 7.3% (n=16) dropped out from school and unemployed.

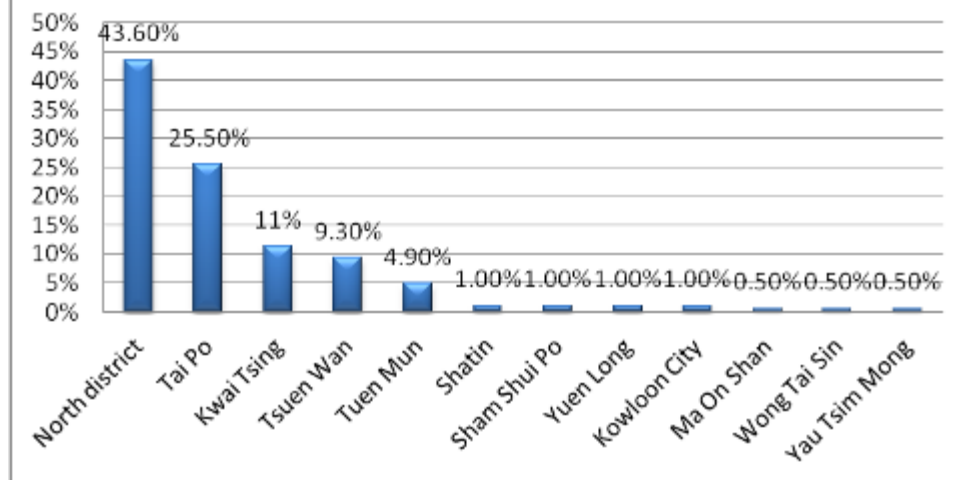


Most subjects 43.6% (N=89) lives in North district, 25.5% (N=52) lives in Tai Po, 11.3% (N=23) lives in Kwai Tsing, 9.3% (N=19) lives in Tsuen Wan and 4.9% (N=10) lives in Tuen Mun. 1% (N=2) each lives in Shatin, Sham Shui Po, Yuen Long and Kowloon city, while 0.5% (N=1) each lives in Ma On Shan, Wong Tai Sin and Yau Tsim Mong.

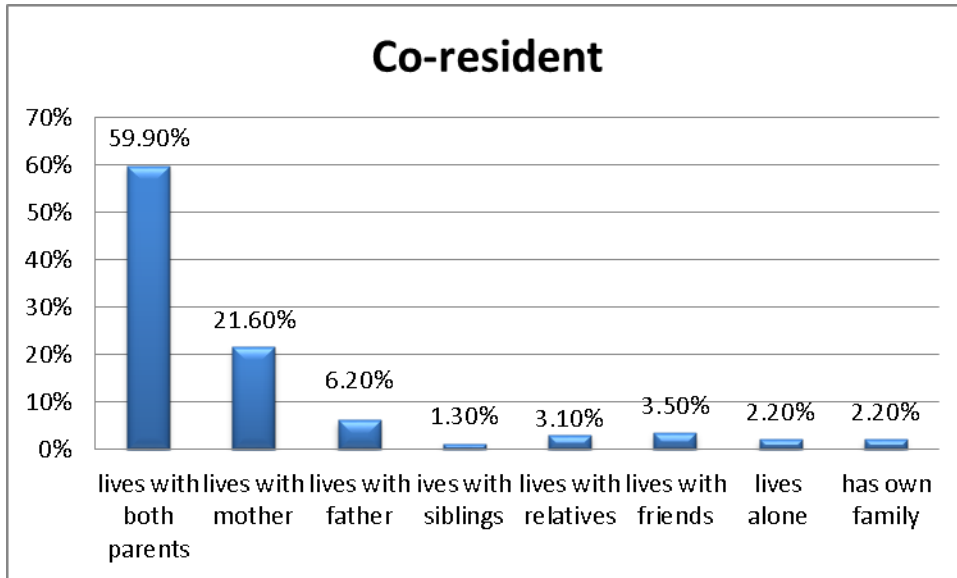
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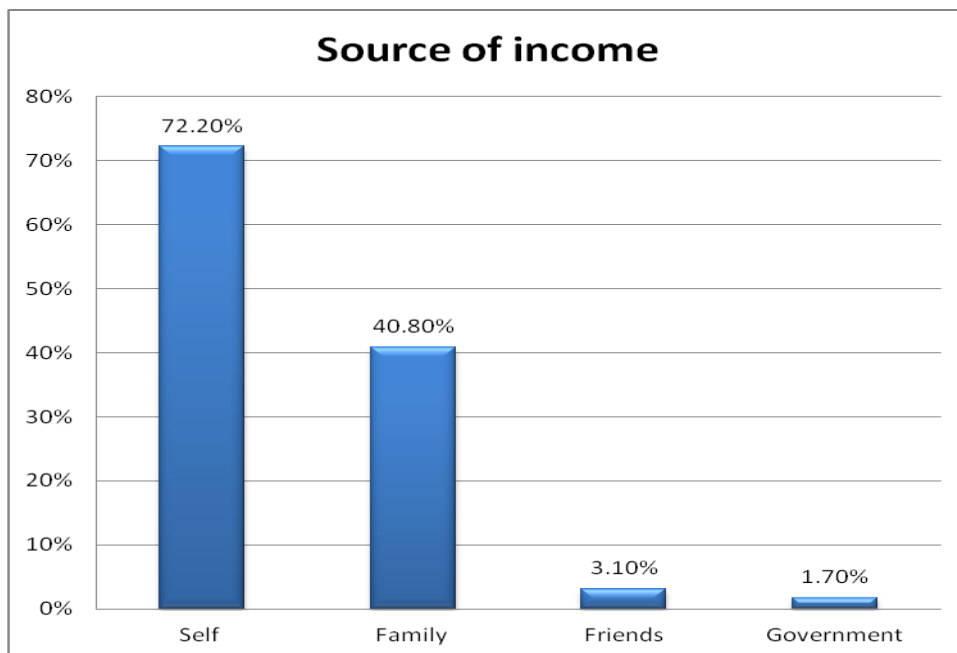
Living district



The majority of subjects lived with a family members: about 60% (n=136) subjects lives with parents. 67% (N=154) subjects lives with father and siblings, 71.3% (N=164) lives with mother and sibling, 1.3% (N=3) lives with siblings only. Only 3.1% (N=7) lives with relatives, 3.5% (N=8) lives with friends, 2.2% (N=5) lives alone and 2.2% (N=5) have their own family.



72.2% (N=161) of the subjects were financially self-supporting while 40.8% (N=91) relied on money from their families (some respondents chose both options), 3.1% (N=7) were supported by friends and a further 1.7% (N=4) lived on government welfare.



13.1% (N=29) subjects reported family psychiatric history while 14.8% (N=33) reported suicidal and self-harm experience.

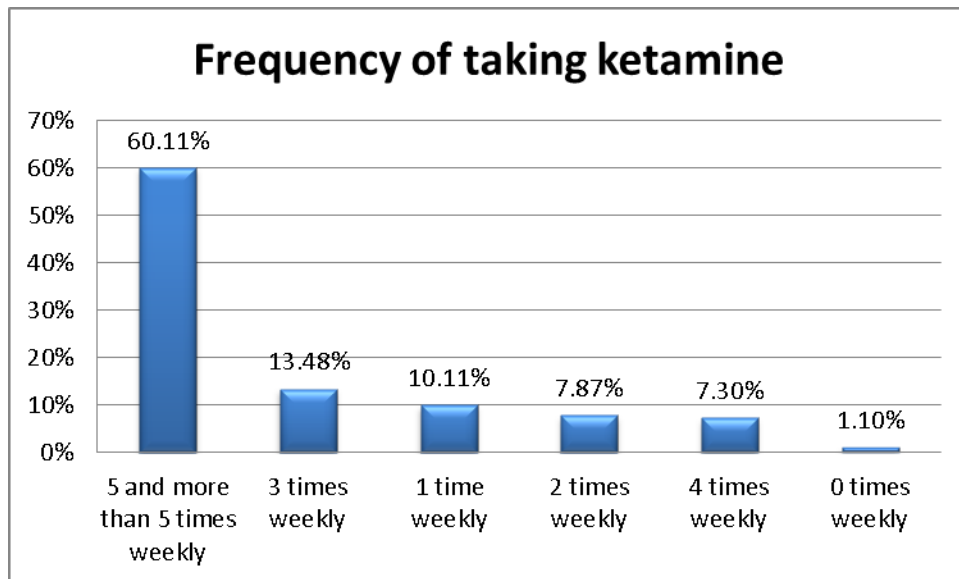
Patterns and Characteristics of substance use

The mean age of initiation of substance use was 15.08 years (SD=2.723) and the youngest started at age 9. A total of 197 (86.8%) subjects admitted having used ketamine while 10 (4.5%) denied ever having taken the drug. Data from 6 subjects were incomplete. The rest admitted having used other substances.

Most subjects (N=195, 84.8%) preferred using ketamine by snorting. 115 subjects provided the duration of their ketamine use. Duration of substance use ranged from 0.5 to 14 years, with one subject taking drug for 14 years. The mean duration of ketamine use was 4.64 years (55.7978 months) (SD=2.95). Of these subjects 182(79.1%) had been using the drug for more than 4 years, 14.3% for between 2 and 4 years, 3% for 1 to 2 years and only 3.5% for less than 1 year. Mean dosage of ketamine consumption per time was 1.73 g (SD= 1.78 g), with minimum dosage of 0.1 g and maximum dosage of 14g. 107 subjects (60.11%) reported taking ketamine more than or equal to five times per week; 24 subjects (13.48%) taking 3 times per week; and 18 subjects (10.11%) taking 1 time per week.

Table 1. Frequency of taking Ketamine

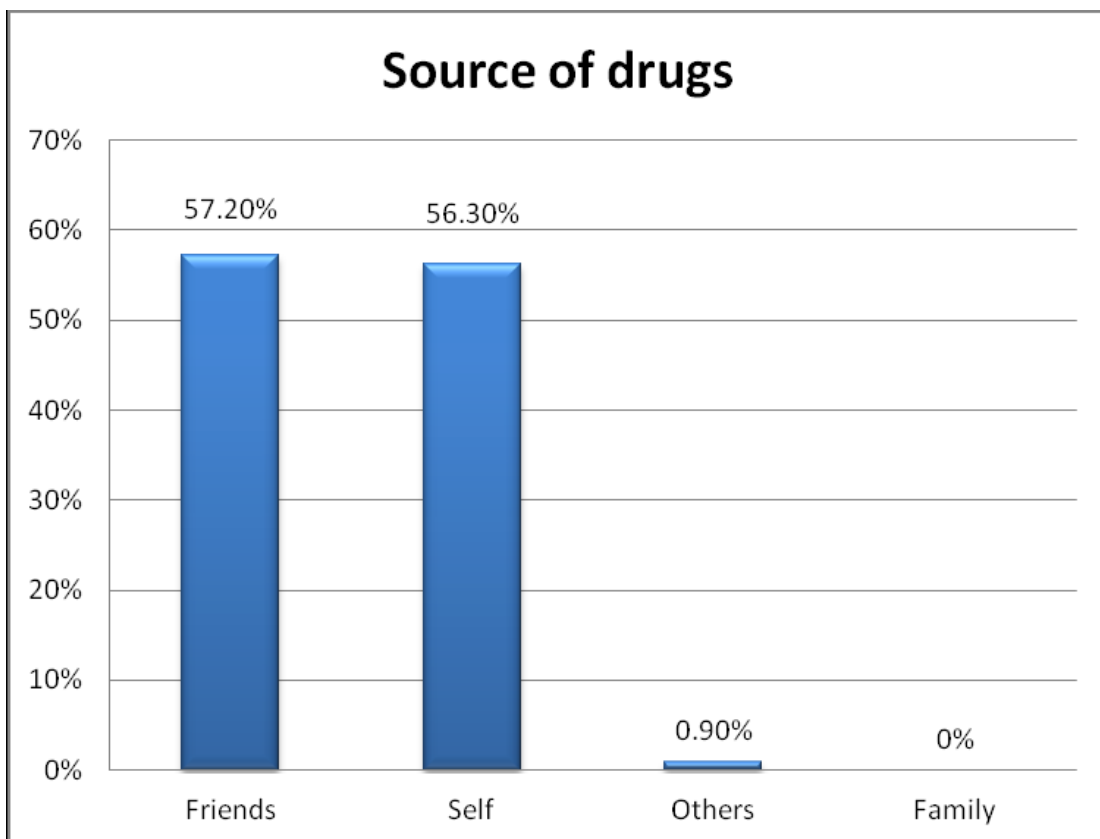
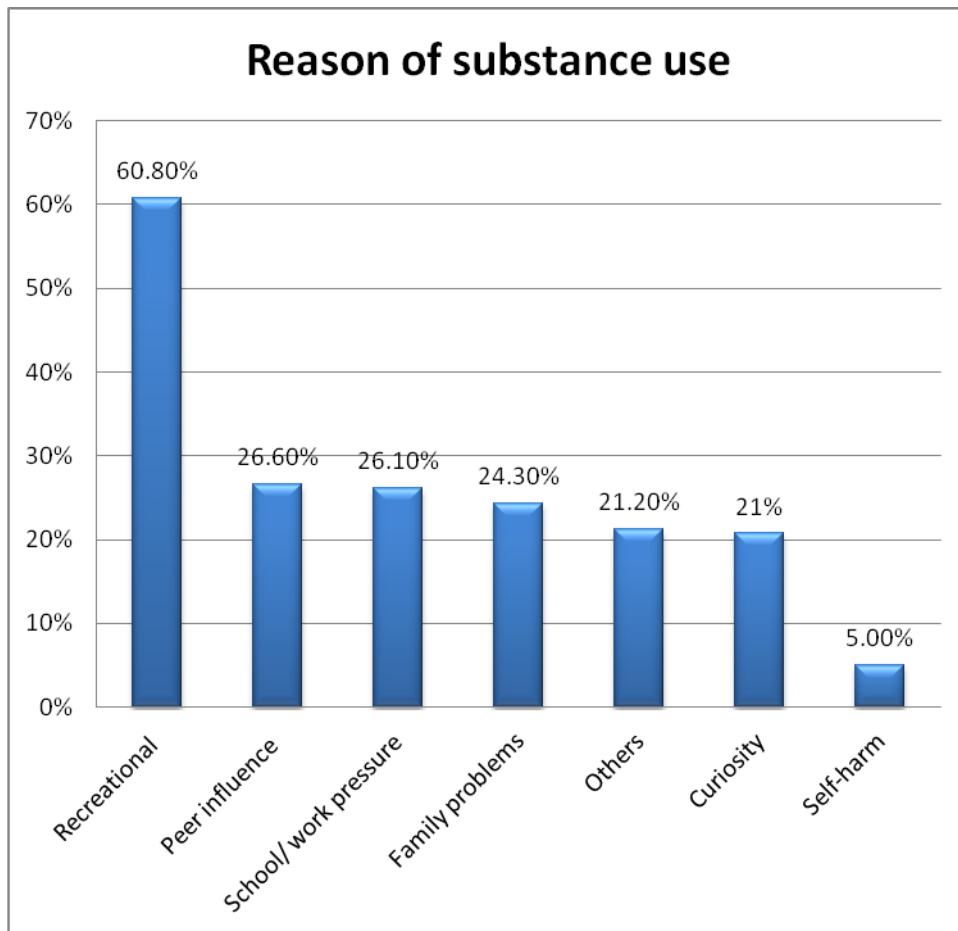
Frequency of taking Ketamine (per week)	
0	2 (1.12%)
1	18 (10.11%)
2	14 (7.87%)
3	24 (13.48%)
4	13 (7.30%)
>=5	107 (60.11%)
Total	178



Major source of drugs comes from their friends (57.2%). Half (56.3%) of the users could purchase the drugs by themselves. Monthly expenses on drugs varied widely, from zero dollar (means free of charge) to huge monthly expenses as much as \$HK132200. The median of monthly expenses was \$1425. 60.8% ketamine users reported episodic binges as well.

Table 2. Reason of substance use

Reason of substance use (n=222)	
Recreational	135 (60.8%)
Peer influence	59 (26.6%)
Curiosity	46 (20.7%)
School/ work pressure	58 (26.1%)
Family problems	54 (24.3%)
Self-harm	11 (5%)
Others	47 (21.2%)
Source of substance (n=222)	
Self	125 (56.3%)
Family	0 (0%)
Friends	127 (57.2%)
Others	2 (0.9%)

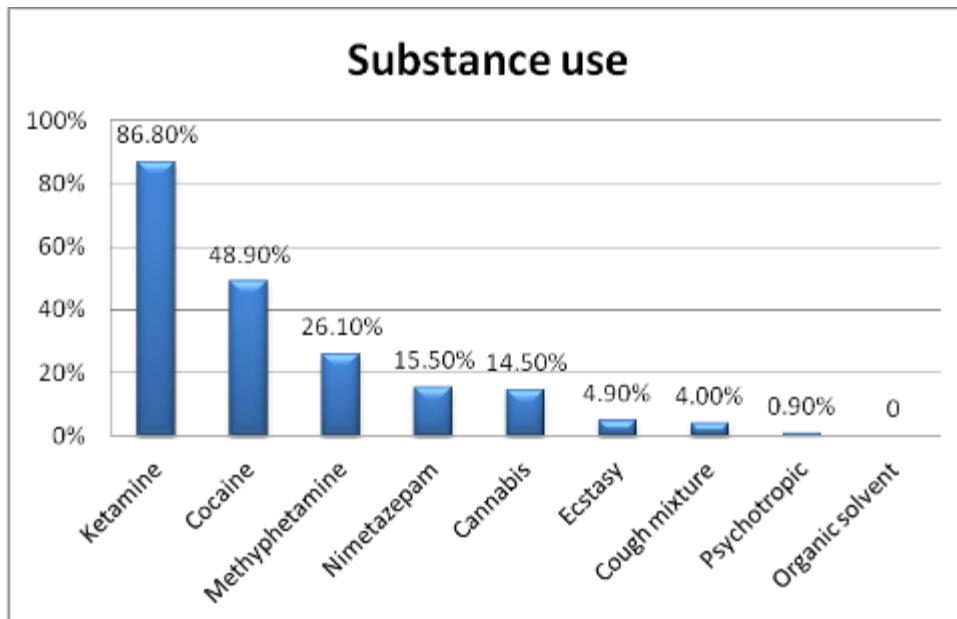


Of the 218 subjects, 179 (82.1%) had thought of quitting drugs and 144 (67.9%) had attempted to do so. There were 26 (11.3%) subjects who reported having ceased ketamine use with 12 of those having abstained for longer than 6 months. 17 subjects had self-harmed when taking the drugs and 47 had been admitted to hospital due to overdose. For the variable "Have thought of quitting drugs in the past three months", there were 218 valid responses and 12 were missing. For the variable "Have tried to give up drugs in the past three months", there were 212 valid responses and 18 were missing.

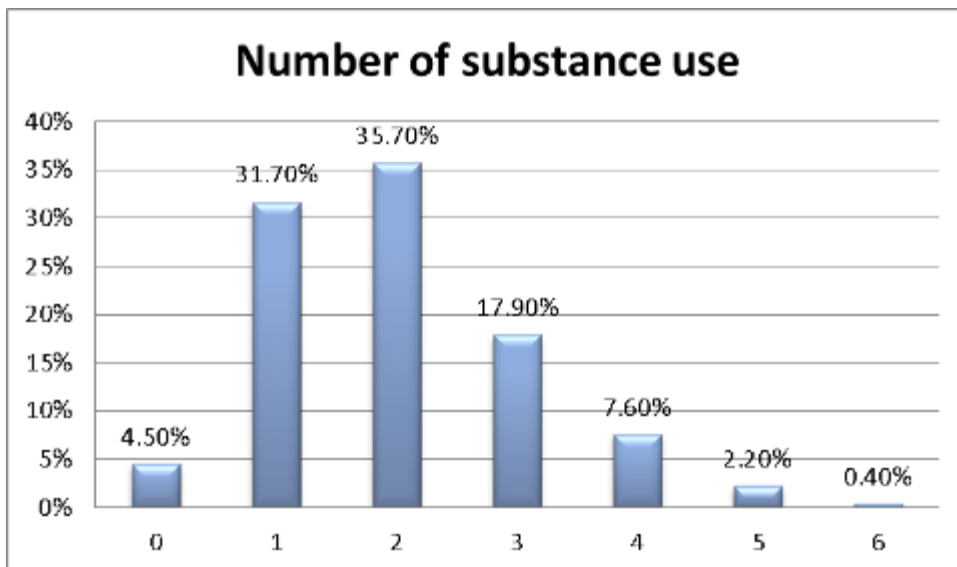
Are the health conditions worse off for those using additional drugs?

Among 230 participants, 62.2% were poly-substance abusers and 30.9% were primary ketamine abusers. To compare their health conditions, poly-substance abusers had more self-reported physical and psychological symptoms than primary ketamine abusers. (sig.=0.003) It was difficult to figure out which combination in particular as they used many drugs at the same time.

Use of multiple drugs was reported by 62.2% (n=143) of the ketamine users, with the most common additional drugs being cocaine (48.9%), methamphetamine (26.1%), zolpidem (15.5%) and cannabis (14.3%). Half ketamine users reported consuming alcohol while taking the drug. Only 37.4% of them admitted themselves as dependent to the substance use. The percentages shown are among all 230 respondents.



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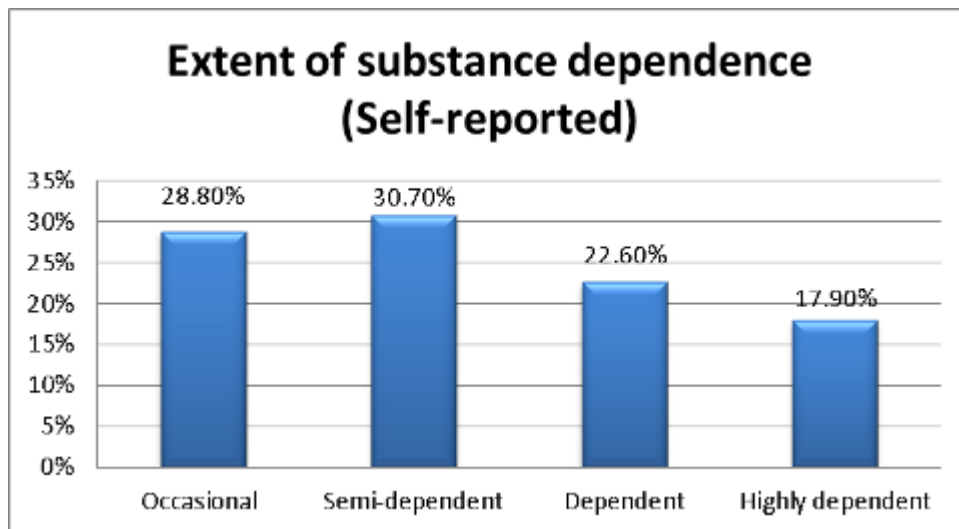
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Of those admitting to substance dependency (37.4%), are there differences between them and others (gender, age, years of drug usage)?

No difference was found between those admitting to substance dependency in gender. (sig.=0.302) There was no relationship between gender and substance dependency. (sig=0.351)

Difference was found between those admitting to substance dependency with different age group (14-23, 24-33, 34-42) (sig=0.000). There was a strong relationship between age group and the substance dependency (sig=0.000)

Difference was found between those admitting to substance dependency with different year of drug usage (More than 4 years, 2-4 years, 1-2 years, less than 1 year) (sig=0.003)



[Total = 212]

Urine toxicology Point of care device (POCT)

Amphetamine (AMP)(N=220) & Methamphetamine (MET)(N=219):

From urine POCT, there were 38 subjects with positive Amphetamine (AMP). From self-reported drug, there were 59 subjects admitted taking methamphetamine. There were 7 subjects who did not report taking methamphetamine with positive Methamphetamine (MET) or AMP while 1 subject who did not report taking methamphetamine with weak positive MET or AMP.

Cocaine (COC)(N=220):

From urine POCT, there were 58 subjects with positive Cocaine (COC). From self-reported drug, there were 111 subjects admitted taking cocaine. There were 13 subjects who did not report taking cocaine with positive Cocaine (COC) while 4 subjects who did not report taking cocaine with weak positive Cocaine (COC).

Cannabis (THC)(N=220):

From urine POCT, there were 26 subjects with positive Cannabis (THC). From self-reported drug, there were 33 subjects admitted taking cannabis. There were 12 subjects who did not report taking cannabis with positive THC while 8 subjects who did not report taking cannabis with weak positive THC.

Benzodiazepine (BZO)(N=220), Tricyclic antidepressant (TCA)(N=220)

From urine POCT, there were 15 subjects with positive Benzodiazepine (BZO); 89 subjects with positive Tricyclic antidepressant (TCA); 7 subjects with positive THC. However, there were only 2 subjects reported taking psychotropic drugs. There were 73 subjects who did not report taking psychotropic drugs with positive TCA while 13 subjects who did not report taking psychotropic drugs with weak positive TCA. There were 3 subjects who did not report taking psychotropic drugs with positive BZO while 11 subjects who did not report taking psychotropic drugs with weak positive BZO. There were 6 subjects who did not report taking psychotropic drugs with weak positive THC.

Ketamine (KET)(N=220):

From urine POCT, there were 141 subjects with positive Ketamine (KET). From self-reported drug, 197 subjects admitted taking ketamine. There were 8 subjects who

did not report taking ketamine with positive KET while 3 subjects who did not report taking ketamine with weak positive KET.

MDMA/ Ecstasy(N=219):

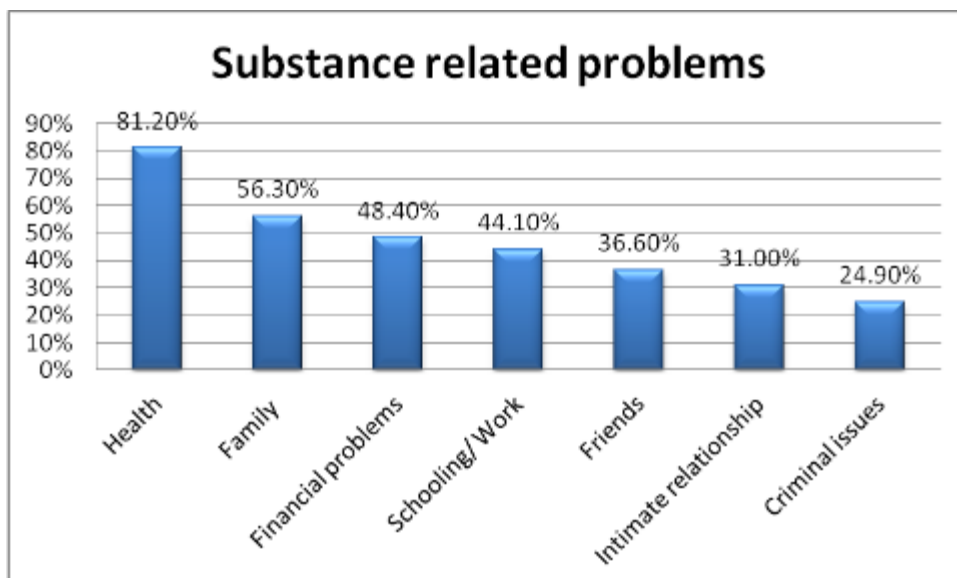
From urine POCT, there were 20 subjects with positive MDMA. However, there were only 11 subjects reported taking ecstasy. There were 7 subjects who did not report taking MDMA with positive MDMA while 10 subjects who did not report taking MDMA with weak positive MDMA.

Opiates (OPI)(N=219):

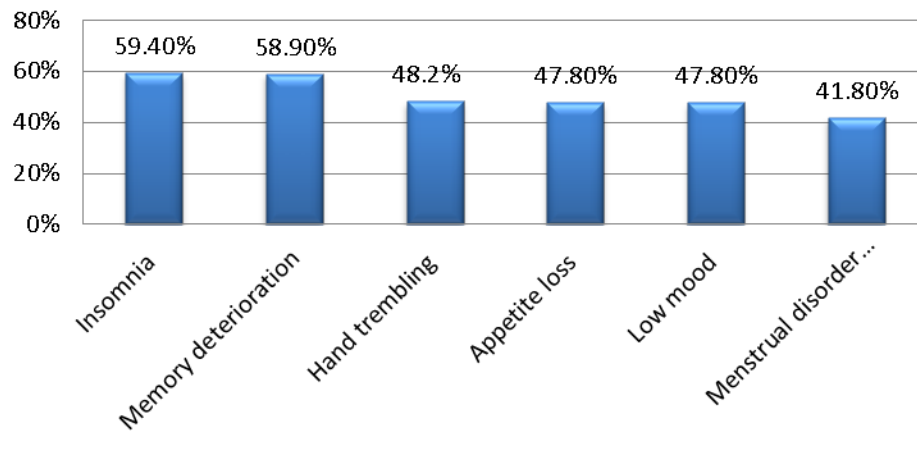
From urine POCT, there were 8 subjects with positive Opiates (OPI).

Other substance related problem:

Other substance related problems are also commonly reported: majority (81.2%) [total =213] of the subjects encountering problems associated with physical health; 56.3% reported problems with family; 48.4% indicated financial difficulties; 44.1% reported difficulties at school or work; 36.6% and 31% reported problems with friendship and intimate relationship respectively; and 24.9% reported substance related forensic history. The six most common self-reported physical and psychological symptoms in the present sample were memory impairment (58.9%), insomnia (59.4%), hand trembling (48.2%), low mood (47.8%), menstrual disorder (41.8%) and appetite loss (47.8%). Only 21.6% (47) have gone to medical institutions for medical consultation in the past three months.



The six most common self-reported physical and psychological symptoms



Body mass index

This is not a normal distributed population. ($p < 0.05$) The median BMI is 20.2 (range 14.6-34.3). The median males BMI is 20.7 (range 14.6-34.3) The median females BMI is 18.7 (range 14.6-25.7)

Table 3. BMI frequency distribution

BMI	Frequency	Percentage
Underweight	66	29.5
Normal	112	50
Overweight	29	12.9
Obese	13	5.8
Severely obese	4	1.8
Sub-total	224	100
Missing	6	
Total	230	100

Table 4. Cross tabulation of BMI and gender

Males BMI			Females BMI		
	Frequency	Percentage		Frequency	Percentage
Underweight	34	21.0	Underweight	32	47.8
Normal	79	48.8	Normal	32	47.8
Overweight	28	17.3	Overweight	1	1.5
Obese	12	7.4	Obese	1	1.5
Severely obese	4	2.5	Severely obese	0	0
Sub-total	157	96.9	Sub-total	66	98.5
Missing	5	3.1	Missing	1	1.5
Total	162	100.0	Total	67	100.0

*There was one subject whose sex is unknown, BMI categories couldn't able to define.

Test any difference of BMI between male and female:

The group means are significantly different as the p value is less than 0.05. (p=0.000)

Female is more likely to be underweight than male in this population. (=16.051, p=0.000)

BMI (by living district):

BMI level and living district are not significantly associated. (p=0.568) Comparing the four districts where more subjects lived in, more underweight subjects was living in Tai Po district (39.2%).

Table 5. Cross tabulation of BMI and living districts

Living district		Underweight	Normal	Overweight	Obese	Severely obese	Total
North District	Count	28	40	13	5	1	87
	% within Living district	32.2%	46.0%	14.9%	5.7%	1.1%	100.0%
Tai Po	Count	20	20	8	1	2	51
	% within Living district	39.2%	39.2%	15.7%	2.0%	3.9%	100.0%
Tsuen Wan	Count	4	11	1	2	1	19
	% within Living district	21.1%	57.9%	5.3%	10.5%	5.3%	100.0%
Kwai Tsing	Count	8	8	5	1	0	22
	% within Living district	36.4%	36.4%	22.7%	4.5%	.0%	100.0%

BMI: Correlation with dosing, frequency, and duration of ketamine abuse

Subjects were asked to estimate the dosing of ketamine abuse they inhaled by adding its equivalent weight in table salt to an electronic balance scale. The frequency of abuse is the number of days of abuse per week. The overall duration of ketamine use was recorded along with the concurrent drug usage details. The frequency of taking ketamine and BMI were negatively correlated but the correlation was weakly significant. ($r=-0.171$, $p=0.024$) The dosage of ketamine use was weakly and significantly correlated with BMI. ($r=0.154$, $p=0.035$) No correlation was found between duration of ketamine use and BMI.

Correlations

	BMI	Drug history: ketamine duration (months)	Frequency of taking drugs(Per week)	Ketamine used each time equal to the gm of table salt (gm)
BMI Pearson Correlation	1	.092	-.171 [*]	.154 [*]
Sig. (2-tailed)		.331	.024	.035
N	224	114	174	187

Peak flow rate

The mean peak flow rate was 442L/min (range 145-640)

Table 6. Peak flow rate frequency distribution

Peak flow rate	Frequency	Percentage	Cumulative Percentage
26-50%	6	4.8	4.8
51-75%	30	23.8	28.6
76-100%	78	61.9	90.5
126-150%	12	9.5	100.0
Sub-total	126		
Missing	104		
Total	230		

Peak flow rate percentage: Correlation with dosing, frequency, and duration of ketamine abuse

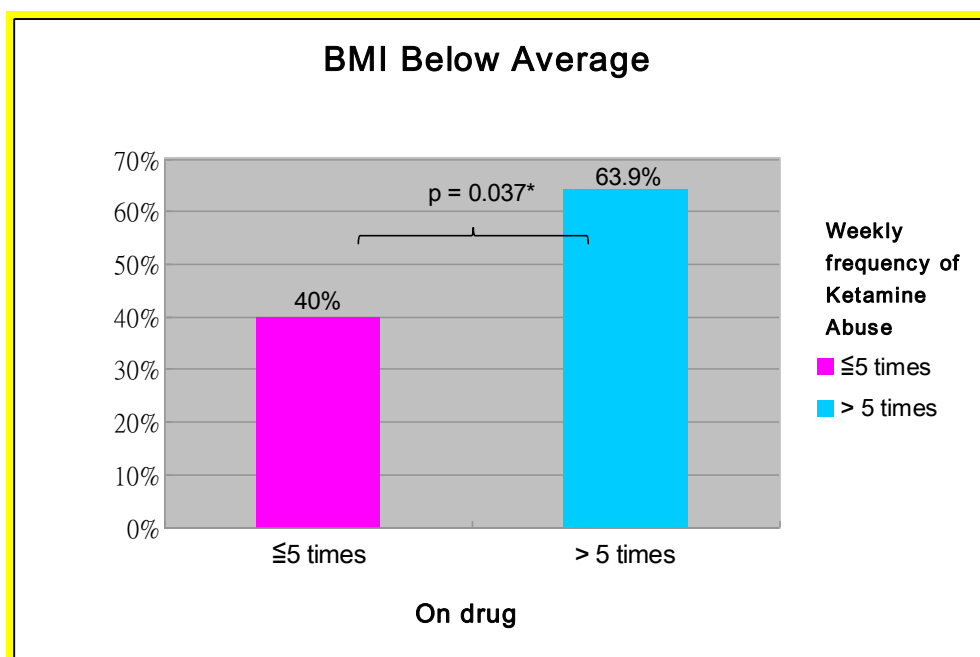
No significant correlation between peak flow rate percentage and duration of ketamine use. No significant correlation between peak flow rate percentage and frequency of taking ketamine. No significant correlation between peak flow rate percentage and dosage of ketamine use.

Cases analysed by Physiotherapy Team

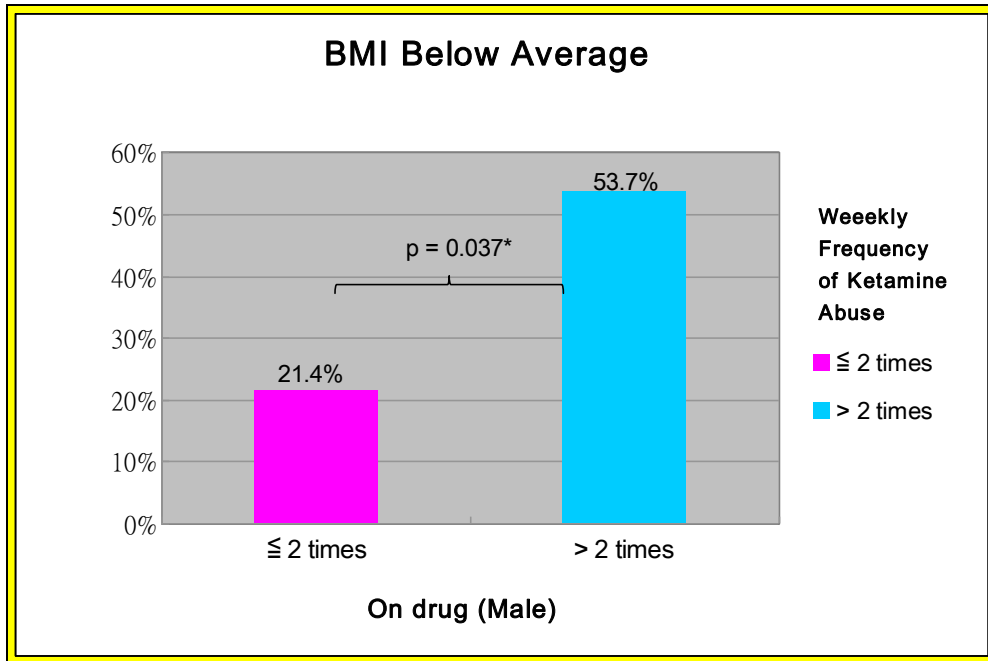
Among 110 ketamine abusers who had completed all the physio stations, 72.7% is male. The mean age is 20.8 years old (SD 4.3). The mean duration of ketamine abuse is 4.8 years (SD 2.9) and the mean ketamine abuse frequency is 12.6 times per week (SD 21.1). Some of the clients did not perform physical assessment due to unstable condition or subjective complaint of feeling unwell. Some of them refused to perform the assessment despite explanation and encouragement given.

Body Mass Index (BMI)

Among 104 ketamine abusers, 50% result in BMI below average. For those with ketamine abuse more than 5 times/week, the risk of suffering BMI below average is significantly higher than those who abuse less ($p=0.037$).

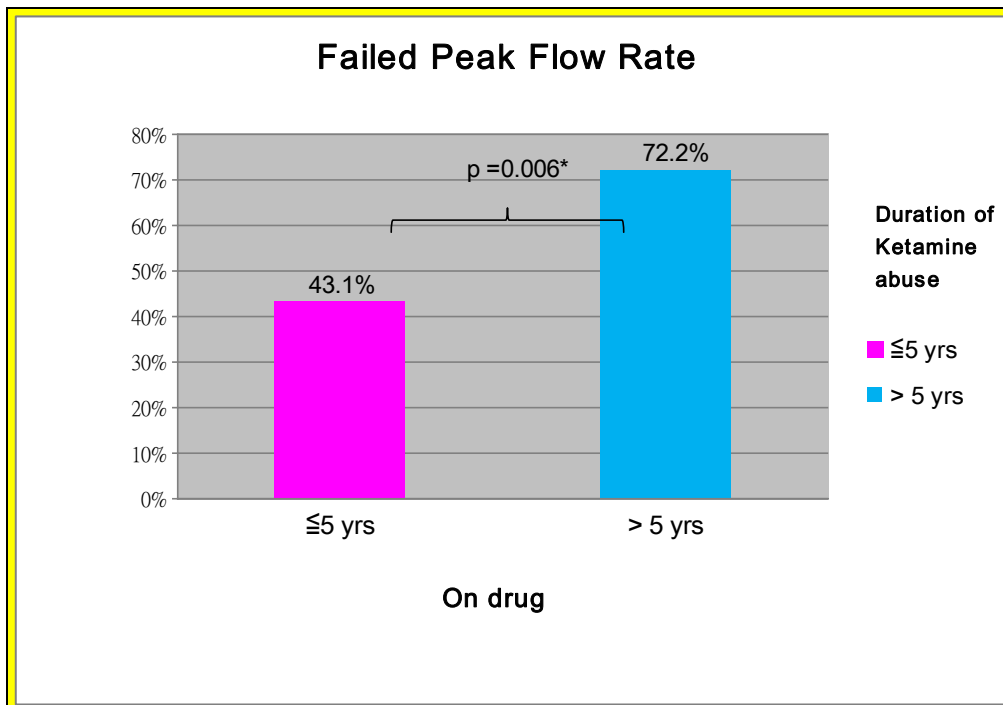


For male abusers with ketamine abuse frequency more than 2 times/week, the risk of BMI below average is 2.5 times of those who abuse less ($p=0.037$).



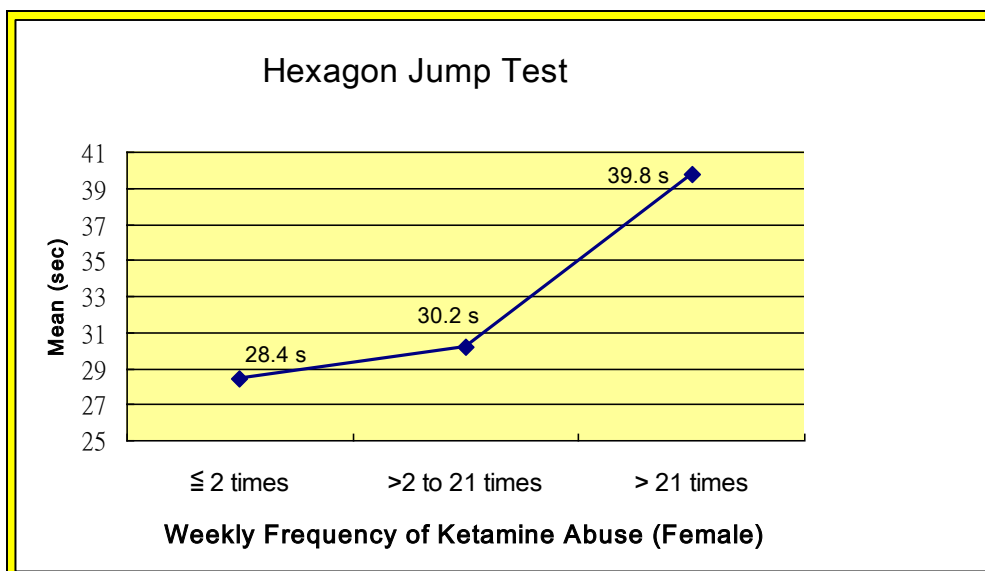
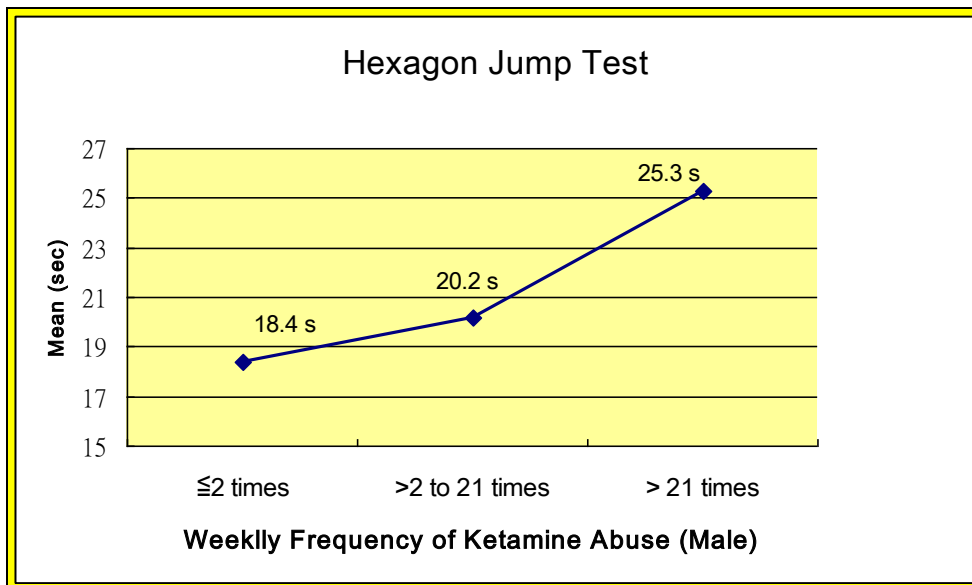
Peak Flow Rate (PFR)

Among 100 ketamine abusers, 53% fail in PFR Test which indicates poor lung function. For those with ketamine abuse more than 5 years, the risk of poor lung function is significantly higher than those who abuse less ($p=0.006$).



Hexagon Jump Test

For both male and female, worse performance is resulted with more frequent ketamine abuse.



Shuttle Run Test

The mean performance of shuttle run test for male (N=71) and female (N=25) is 23.7 seconds (SD 4.8) and 27.8 seconds (SD 4.3) respectively. There is no significant difference in the performance of shuttle run test among subjects with different ketamine abuse frequency and duration.

Balance Test

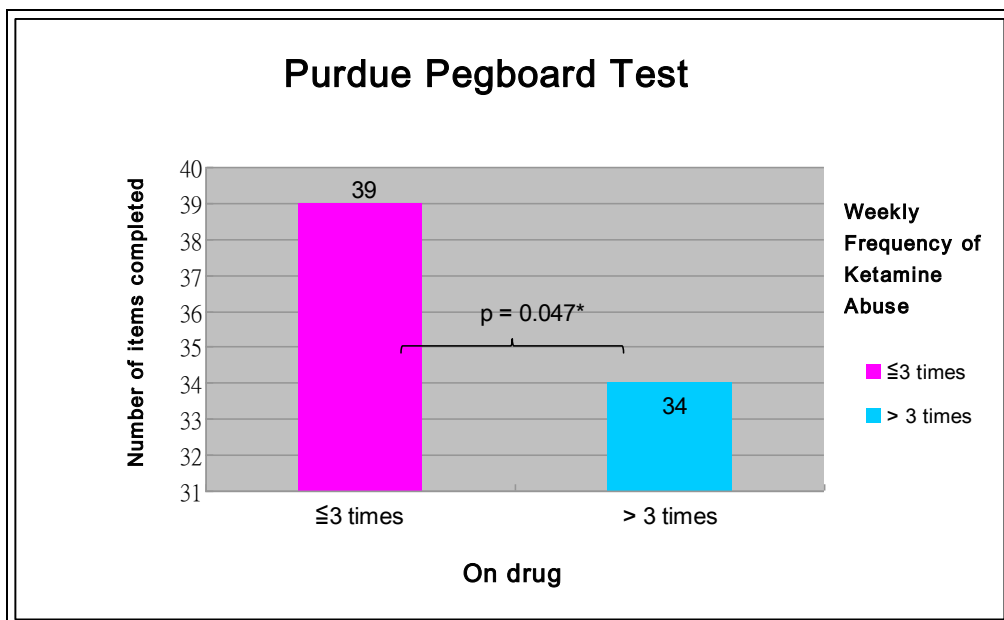
The mean performance of balance test for male (N=75) and female (N=28) is 13 seconds (SD 3.9) and 17.5 seconds (SD 4.7) respectively. There is no significant difference in the performance of balance test among subjects with different ketamine abuse frequency and duration.

Step Test

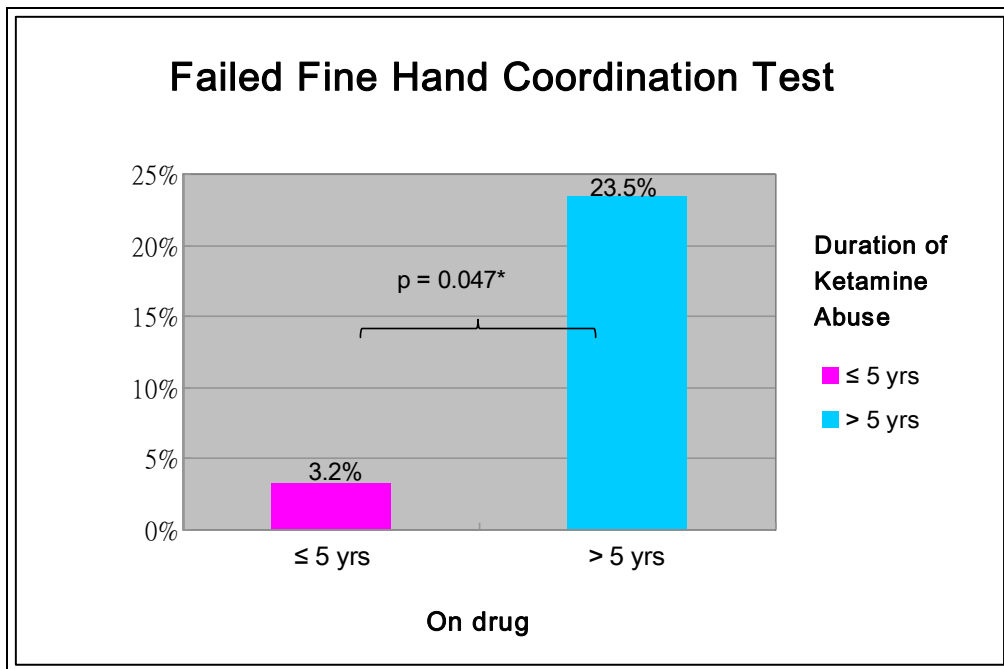
In this test, we stress their cardiovascular stress by stepping on and off a platform over a period of time. Among 74 male ketamine abusers, 5.4% fail in step test. All 28 female ketamine abusers pass in step test. This may be an overestimation of success if the subjects did not complied to the instruction and not stressed their cardiovascular system hard enough. The rhythm of step test was slower in most female subjects because they could not follow the command even reinforcement and encouragements were given. The heart rate in exertion was therefore lower than the true positive result which caused overestimation of their performance.

Fine Hand Coordination

Among 52 ketamine abusers, 40.4% fail in the overall fine hand coordination. In Purdue Pegboard Test, those with weekly ketamine abuse more than 3 times per week significantly perform worse than those who abuse less ($p=0.047$).

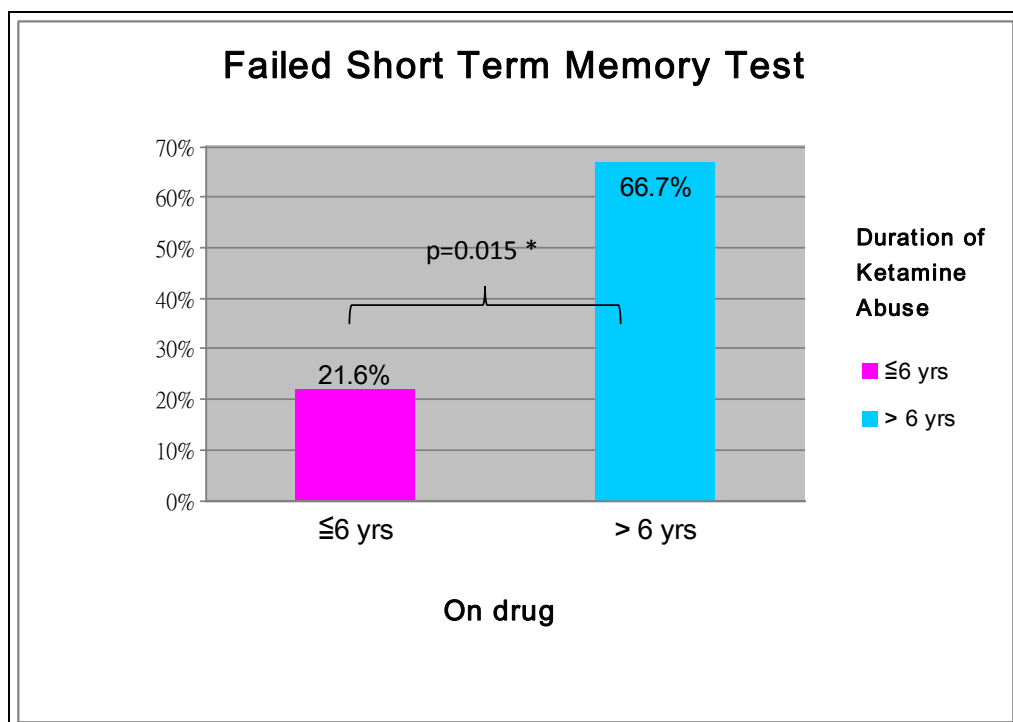


In another fine hand coordination test, the failure rate of those with ketamine abuse for more than 5 years is 7 times to those who abuse less ($p=0.047$).



Cognitive Function

Among 29 ketamine abusers, 69.4% fail in the overall cognitive function. In one of the short term memory tests, the failure rate of those with ketamine abuse for more than 6 years is 3 times to those who abuse less ($p=0.015$).



Cases analysed by Occupational Therapy Team

76 clients were assessed on perceptual motor and memory (visual and verbal) aspects.

Results were summarized in the following table:

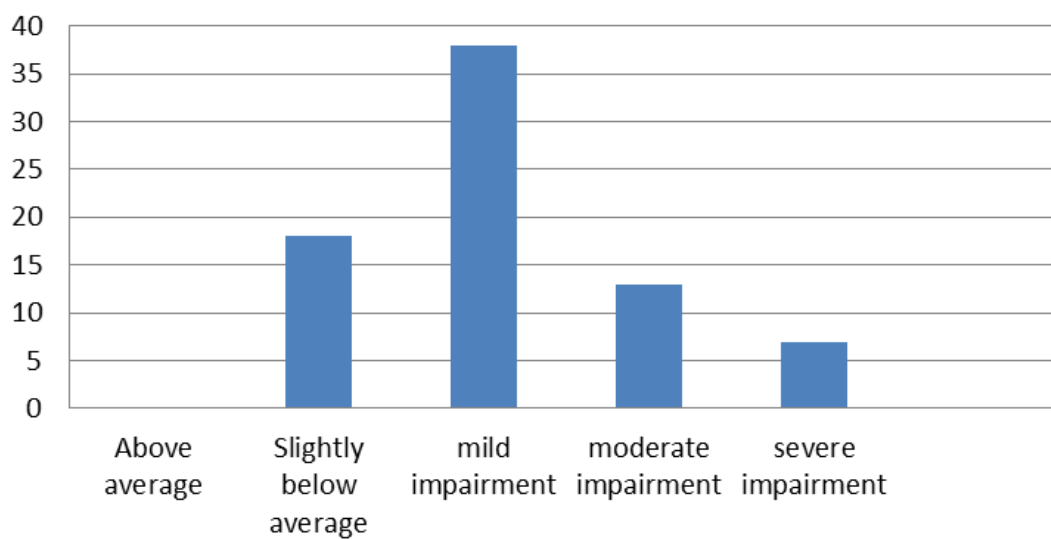
Table 7. Cross tabulation of perceptual motor and memory with standard deviation

Perceptual motor	Frequency	Memory	Frequency
Above average	37	Above average	0
Slightly below average	17	Slightly below average	18
mild impairment	13	mild impairment	38
moderate impairment	3	moderate impairment	13
severe impairment	1	severe impairment	7
Missing	5	Missing	0
Total	76	Total	76

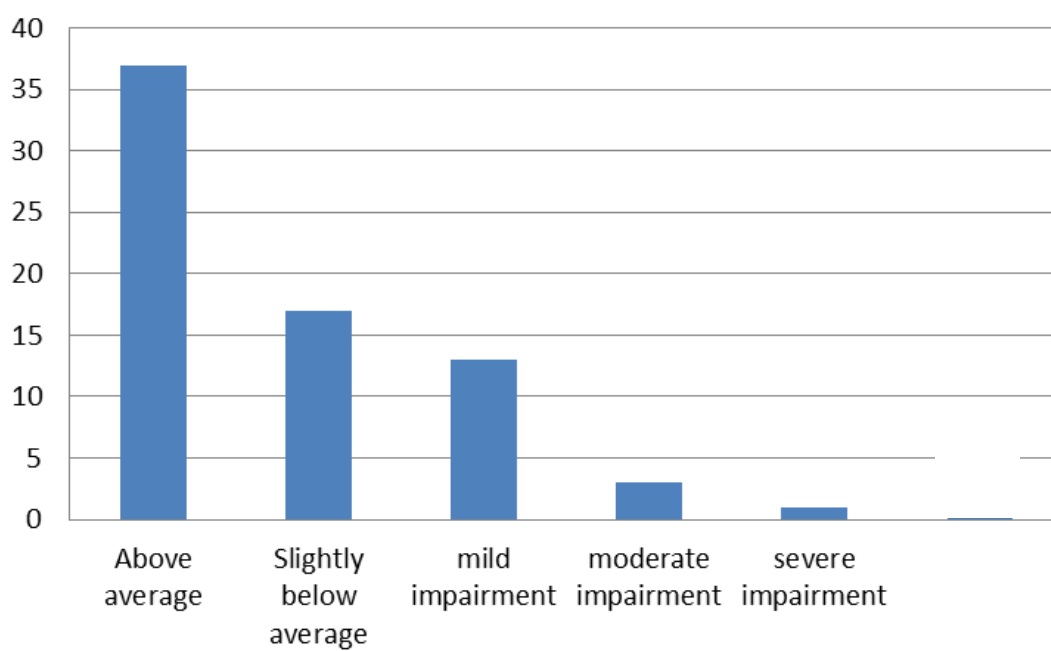
The mean age in this subgroup analysis is 21. There are 24 female and 52 male. Twenty eight of them are working class, 5 are students, 13 are unemployed. The occupation of 29 subjects was not disclosed to us.

Fifty eight clients had impairment in at least one aspect. Results indicated that memory was more prominently affected in this group of clients mainly abusing Ketamine. The clients reported similar problems during interview. They were more aware of the impact on their daily living after counselling. Clients with moderate to severe impairment were encouraged to attend treatment for learning coping strategies. 24% of those having impairment (14 out of 58 clients) had impairment in both perceptual and memory aspects. These clients might anticipate more problems in coping with daily living and work tasks.

Memory Assessments Results



Perceptual motor Assessment Results



Cases analysed by Urology team & Urology Nursing Team

Pelvic Pain Urgency and Frequency questionnaire (PUF)

The mean total, symptom and bother scores were 9.5, 6.4 and 3.0 respectively.

PUF symptom score: Correlation with dosing, frequency, and duration of ketamine abuse

The frequency of taking ketamine was moderately and significantly associated with PUF symptoms score. ($r=0.316$, $p=0.000$) No significant correlation was found between PUF symptom score and dosage of ketamine use. ($r=0.056$, $p=0.443$). No significant correlation was found between PUF symptom score and duration of ketamine use. ($r=0.067$, $p=0.482$)

PUF bother score: Correlation with dosing, frequency, and duration of ketamine abuse

An r value of 0.286 ($p=0.000$) indicates a weak positive linear relationship between bother score and frequency of taking ketamine. No significant correlation was found between PUF bother score and dosage of ketamine use. ($r=0.103$, $p=0.155$). No significant correlation was found between PUF bother score and duration of ketamine use.

PUF total score: Correlation with dosing, frequency, and duration of ketamine abuse

The frequency of taking ketamine was moderately and significantly associated with PUF total score. ($r=0.312$, $p=0.000$) No significant correlation was found between PUF symptom score and dosage of ketamine use. ($r=0.056$, $p=0.443$). No significant correlation was found between PUF symptom score and duration of ketamine use. ($r=0.067$, $p=0.482$)

Overactive bladder symptom score (OABSS)

There were about half subjects (47.8%) suffered from overactive bladder symptom. Increase in frequency of ketamine use would increase the chance of having

overactive bladder symptom. (Increase one time per week of ketamine use would increase 0.521 times probability of having overactive bladder symptom.)

Severity of OABSS

When grouping the severity of overactive bladder symptoms into mild, moderate and severe level, there were no significant correlation between the duration of ketamine use and the level of overactive bladder symptom. There were no significant correlation between the frequency of taking ketamine and the level of overactive bladder symptom. And there were no significant correlation between the dosage of ketamine use and the level of overactive bladder symptom.

Void volume by cup measure

The mean voided volume was 280ml (range 13-825). The frequency of taking ketamine was negatively correlated with void volume but the correlation was weak.

Post void residual bladder volume by bladder scan

The mean post void residual bladder volume was 37ml.No correlation was found between post void bladder scan and the duration or frequency or dosage of ketamine use.

Uroflowmetry

Frequency distribution of uroflowmetry (Average flow rate, Max flow rate, time to max flow, void volume, flow time, void time) is listed in the table below:

Average flow rate (ml/s): Correlation with dosing, frequency, and duration of ketamine abuse

For all subjects, duration of ketamine use and average flow rate have a weak, negative relationship. ($r=-0.293$, $p=0.002$) For all subjects, frequency of taking ketamine and average flow rate a weak, negative relationship. ($r=-0.249$, $p=0.001$) No significant correlation was found between average flow rate and dosage of ketamine use.

Average flow rate (ml/s): compare normal values of average flow rate with corresponding age and sex

Males (age 14-45)

The normal value of average flow rate for males aged 14-45 is 21 ml/sec. In our sample, the average flow rate for males aged 14-45 is 10.0071 ml/sec. (S.D.= 4.56). The average flow rate of ketamine male users is lower than that of normal males.

Females (age 14-45)

The normal value of average flow rate for females aged 14-45 is 18 ml/sec. In our sample, the average flow rate for females aged 14-45 is 10.23 ml/sec.(S.D.= 5.81). The average flow rate of ketamine female users is lower than that of normal females.

Max flow rate (ml/s): Correlation with dosing, frequency, and duration of ketamine abuse

Duration of ketamine use was negatively correlated with max flow rate and the correlation was moderate. ($r=0.364$, $p=0.000$) Frequency of taking ketamine was negatively correlated with max flow rate but the correlation was weak. ($r=-0.150$, $p=0.049$) No significant correlation was found between max flow rate and dosage of ketamine use.

Time to max flow (s): Correlation with dosing, frequency, and duration of ketamine abuse

No correlation was found between time to max flow and duration of ketamine use. No correlation was found between time to max flow and frequency of taking ketamine. No correlation was found between time to max flow and dosage of ketamine use.

Voided volume (ml): Correlation with dosing, frequency, and duration of ketamine abuse

Frequency of taking ketamine was negatively correlated with voided volume but the correlation was weak. ($r=-0.238$, $p=0.002$) No correlation was found between voided

volume and duration of ketamine use. No correlation was found between voided volume and dosage of ketamine use.

Flow time (s): Correlation with dosing, frequency, and duration of ketamine abuse

Dosage of ketamine use was negatively correlated with flow time but the correlation was weak. ($r=-0.151$, $p=0.037$) No correlation was found between flow time and frequency of taking ketamine. No correlation was found between flow time and duration of ketamine use.

Void time (s): Correlation with dosing, frequency, and duration of ketamine abuse

Dosage of ketamine use was negatively correlated with void time but the correlation was weak. ($r=-0.150$, $p=0.038$) No correlation was found between void time and frequency of taking ketamine. No correlation was found between void time and duration of ketamine use.

Ultrasound measurement of degree of hydronephrosis and bladder wall thickness

Out of 216 subjects with ultrasound performed, we picked up 14 bilateral hydronephrosis, 23 right hydronephrosis and nil left hydronephrosis.

Hydronephrosis: Correlate with the duration of ketamine use

The duration of ketamine use was significantly correlated with having hydronephrosis. ($p=0.021$) It indicated that increase in 1 year ketamine use would increase 0.977 times probability of having hydronephrosis.

Hydronephrosis: Correlate with the frequency of ketamine use

No significant correlation was found between the frequency of ketamine use and having hydronephrosis.

Hydronephrosis: Correlate with the dosage of ketamine use

The dosage of ketamine use was significantly correlated with having hydronephrosis. ($p=0.014$) It indicated that increase in 1 gram ketamine use would increase 0.579 times probability of having hydronephrosis.

Ultrasound measure of bladder wall thickness:

Out of 207 subjects with bladder wall thickness measured, the mean anterior, posterior and lateral bladder wall thickness were 5.0mm, 5.8mm and 5.7mm respectively.

Average Bladder wall thickness (mm): Correlation with dosing, frequency, and duration of ketamine abuse

No significant correlation was found between average bladder wall thickness and duration of ketamine use. No significant correlation was found between average bladder wall thickness and frequency of taking ketamine. No significant correlation was found between average bladder wall thickness and dosage of ketamine use.

Correlations

		Average bladder wall thickness	Drug history: ketamine duration (months)	Frequency of taking drugs(Per week)	Ketamine used each time equal to the gm of table salt (gm)
Average bladder wall thickness	Pearson Correlation	1	-.093	.055	-.121
	Sig. (2-tailed)		.346	.485	.104
	N	207	105	163	181

Bladder wall thickness: Anterior (mm) : Correlation with dosing, frequency, and duration of ketamine abuse

No significant correlation was found between anterior bladder wall thickness and duration of ketamine use. No significant correlation was found between anterior bladder wall thickness and frequency of taking ketamine. No significant correlation was found between anterior bladder wall thickness and dosage of ketamine use.

Correlations

	Bladder wall thickness: Anterior (mm)	Drug history: ketamine duration (months)	Frequency of taking drugs(Per week)	Ketamine used each time equal to the gm of table salt (gm)
Bladder wall thickness: Anterior (mm)	1	-.009	.032	-.056
Pearson Correlation		.930	.683	.451
Sig. (2-tailed)				
N	207	105	163	181

Bladder wall thickness: Posterior (mm) : Correlation with dosing, frequency, and duration of ketamine abuse

No significant correlation was found between posterior bladder wall thickness and duration of ketamine use. No significant correlation was found between posterior bladder wall thickness and frequency of taking ketamine. No significant correlation was found between posterior bladder wall thickness and dosage of ketamine use.

Correlations

	Bladder wall thickness: Posterior (mm)	Drug history: ketamine duration (months)	Frequency of taking drugs(Per week)	Ketamine used each time equal to the gm of table salt (gm)
Bladder wall thickness: Posterior (mm)	1	-.068	.024	-.130
Pearson Correlation		.488	.757	.080
Sig. (2-tailed)				
N	208	105	164	182

Bladder wall thickness: Lateral (mm) : Correlation with dosing, frequency, and duration of ketamine abuse

No significant correlation was found between lateral bladder wall thickness and duration of ketamine use. No significant correlation was found between lateral bladder wall thickness and frequency of taking ketamine. No significant correlation was found between lateral bladder wall thickness and dosage of ketamine use.

Correlations

	Bladder wall thickness: Lateral (mm)	Drug history: ketamine duration (months)	Frequency of taking drugs(Per week)	Ketamine used each time equal to the gm of table salt (gm)
Bladder wall thickness: Lateral (mm)	1	-.140	.072	-.087
Pearson Correlation				
Sig. (2-tailed)		.153	.359	.243
N	207	105	163	181

Cases analysed by Psychiatry Team

Beck Depression Inventory (BDI)

The mean score is 16.7 (range 0-54)

BDI: Correlation with dosing, frequency, and duration of ketamine abuse

The frequency of taking ketamine was significantly associated with higher BDI total score. ($r=0.208$, $p=0.008$) The duration of ketamine use was weakly and significantly correlated with BDI total score ($r=0.230$, $p=0.017$). No correlation was found between dosage of ketamine use and BDI total score.

The anxiety subscale of the Hospital Anxiety Depression Scale (HADS)

The mean score is 15.4 (range 0-39)

HADS: Correlation with dosing, frequency, and duration of ketamine abuse

The duration of ketamine use was weakly and significantly correlated with higher HADS total score ($r=0.194$, $p=0.046$). No correlation was found between frequency of taking ketamine and HADS total score. No correlation was found between dosage of ketamine use and BDI total score.

Subgroup case-control analysis by Psychiatry team

There were 120 subjects with lifetime use of ketamine, aged 14 to 24 years (mean = 18.94 years, $SD=2.88$ years) recruited. 77 (64.2%) were males and 43 (35.8%) were females. Among them, 45% ($n= 54$) were employed, 26.7% ($n= 32$) were unemployed, 17.5 % ($n= 21$) were students and 8.3% ($n=10$) dropped out from school. [Valid data: 117, missing data: 3] The controls were matched for age and gender ratio. All controls were students.

Pattern and Characteristic of substance use

The mean age of initiation of substance use was 14.48 years ($SD=1.87$) and the youngest started at age 11. Most subjects preferred using ketamine by snorting. Duration of substance use ranged from 2 to 4 years, with one subject taking drug for

10 years. The mean duration of ketamine use was 4.26 years (SD=2.10). Mean dosage of ketamine consumption per time was 1.86gm (SD= 2.03gm), with minimum dosage of 0.2gm and maximum dosage of 14gm. Eighty four subjects (70%) reported taking ketamine more than five times per week; 8 subjects (6.7%) taking 3 times per week; and 28 subjects (23.4%) taking 1 time per week. 65% ketamine users reported episodic binges as well.

78 out of 120 of the drug users (65%) had tried to quit substances within the past three months. However, all of them remained active user at the time of assessment. Twenty-one out of 120 of the drug users (17.5%) had history of self-harm.

Childhood adversity and substance use

58 subjects (48.3%) had reported experiencing one or more types of childhood adversities prior to age of 16. More subjects had reported childhood adversities compared with the controls (48.3% versus 11.7%; $\chi^2=23.31$, $p<0.001$).

The reported adversity items included physical abuse, parental divorced/separation, parental substance use, parental mental disorder and sexual abuse. Chi-square analyses showed subjects were more likely to have childhood adversities of physical abuse ($\chi^2=8.78$, $p<0.01$), parental divorced/ separation ($\chi^2=7.64$, $p <0.01$) and parental substance use ($\chi^2=9.39$, $p<0.01$).

Substance Use Disorder

The lifetime occurrence of any Substance Use Disorder (abuse or dependence) was 91.7% (n=110). 60.8% met the diagnosis of substance dependence and 30.8% met the diagnosis of substance abuse. Among the cases with diagnosis of Substance Use Disorder, prevalence was higher in men (93.5%) than women (88.4 %) but here is no statistical significance ($\chi^2=0.95$, $p=0.33$).

Mood disturbances - BDI and HADS

Subjects had mean BDI score of 16.1 (SD=10.3) while controls had 5.6 (SD=6.0) (Mann-Whitney U test, $Z= -7.26$, $p<0.001$). The mean BDI score of the subject group suggested that they suffered from mild depression.

Subject group had a mean HADS total score of 16.2 (SD=8.1) while controls had 8.8 (SD=6.7) (Mann-Whitney U test, $Z = -6.16$, $p < 0.001$). There were no differences in BDI and HADS scores between primary ketamine and polysubstance users.

Comparisons: a = Primary ketamine users vs. Control;

b = Polysubstance users vs. Control;

c = Primary Ketamine users vs. Polysubstance user

DSM-IV Mental Disorders

Subjects showed higher occurrence of DSM-IV mental disorders as compared with control. Subjects were more likely to have Substance-induced Psychotic disorder, Substance-induced Mood disorder, Major Depressive disorders and Anxiety disorder.

There is significantly higher occurrence of any DSM-IV Mental Disorder in polysubstance abusers ($X^2 = 4.42$, $p < 0.05$) compared with the primary ketamine users. However, there was no statistical difference in the occurrence of substance-induced psychosis or substance-induced mood disorders between two groups.

Referrals to hospital for further treatment

There were 41 cases (18%) referred to Urology clinic after UROK outreach assessment. 34 cases (15%) were referred to Substance abuse clinic for management of significant psychiatric symptoms.

Limitation of this Study

There are limitations of this study that relate to the unique population studied and the opportunistic nature of data collection. In order to evaluate pre-clinical ketamine effects on the human body, teams of volunteer health professionals liaised with social workers to identify appropriate subjects. Social workers identified key youth facilities that the potential subjects utilized and introduced users to the relevance of gaining health information about the hitherto unknown early effects of ketamine in their peer group. Social workers knew the subjects and introduced them to the research team. As it transpired that the community facilities were not available during the day or early evening and also that ketamine users did not visit the community centres until late at night, the research teams conducted data collection from 8pm until 12am. It is possible that the sample studied may be skewed toward older drug users or those in whom other drug affects that may have engendered antisocial behaviour, distortion of reality, depression and anxiety had not developed. Also, in the environment of an outreach clinic, it was difficult to specify whether the case was a non-drug user or not. As the hidden nature of abusing psychotropic substance is prevailing, it is becoming more difficult to recruit younger ketamine abuser for body check. Although males are known to use ketamine more than females, it is possible that the time of data collection influenced the gender discrepancy seen in this series.

There are a number of confounding factors in this study that will need to be controlled for within this population. The physical symptoms should be tightly defined and proportion of ketamine users reporting each should be stratified for general health status and use of other substances. Prevalence should be compared to the population rates for community-dwelling young adults. The practice of using

multiple drugs was common, reported in 63.8% of subjects. Alcohol was consumed at the time of ketamine use by half of active users. Drug interactions are thus likely, making the individual effect of ketamine on the LUT and neurocognitive system difficult to identify.

Since there was no confirmation on the Point of Care Device (POCT) results, the results would have intrinsic limitations of the occurrence of false-positive and false-negative. False-positive or false-negative would be relatively higher for some types of drugs and their occurrence together with the cut-off of each drug might complicate the test results. For those weak positive results, they might be borderline cases. If they were classified as positive, the number of multi-drug users would be more.

The composition of ketamine inhaled may have varied between subjects. It is known that the drug is frequently mixed with varying compounds ranging from broken glass to cleaning powder. The heterogeneity of the drug is shown in the point of care device urine test result. In this study we did not obtain samples of the ketamine used and thus did not perform composition analysis to ensure heterogeneity of the drug. Some of the effects noted on the LUT may have been related to substances/chemicals aside from ketamine.

This study has not developed our understanding of the more dangerous signs of secondary vesicouretric reflux, hydronephrosis and renal failure in ketamine users. Neither has it shed light in the etiology of epigastric dysfunction in this population. Evaluation of these conditions would require more sophisticated assessment tools that are hospital, rather than community-based. High compliance with hospital appointments in this well population would not be expected. Accordingly, a sample size powered for the relative low proportion of upper urinary tract symptoms in a community-dwelling population is required. Data should be collected longitudinally, checked for validity and analysis stratified for ketamine use duration and frequency.

Insight from this study

This study identified the relative risk of dosage, frequency and duration of ketamine abuse for changes in body system functions and the extensiveness of damage caused in community young adults. We help abusers to formulate a directional plan of quitting drugs in term of scientific evidence. We can counsel them to reduce dosage of drug each time, to reduce frequency of abuse each week and to decrease duration of abuse by joining detox program.

Press Conference



COMMUNICATIONS AND
PUBLIC RELATIONS OFFICE

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Press Releases

25 August 2011

CUHK Discovers Drug Dosage Brings Negative Impact on Bladder Function among
Young People

Youth drug abuse problem in North District showed signs of improvement in the past three years. According to the Central Registry of Drug Abuse of Narcotics Division, Security Bureau of HKSAR, the number of first reported drug addicts under the age of 21 in North District significantly decreased from a peak of 261 to 161 in the past three years. Since 2009, a team of multi-disciplinary volunteer health professionals has been set up in North District Hospital. They hosted outreach clinic in collaboration with local social workers to screen youth with a history of ketamine abuse. The body screening results were used to let the abusers to understand the detrimental effect of drug abuse. This approach helps to motivate young drug abusers to quit.

The Division of Urology of the Department of Surgery at The Chinese University of Hong Kong (CUHK) further analysed the urinary system data and found that the majority of young people with history of ketamine abuse had urinary bladder problems. The study results were presented in the American Urological Association Annual Meeting, San Francisco, California in May 2010 and published in the August 2011 issue of the *Journal of Urology*.

The study analysed 66 young people with history of ketamine abuse. Lower urinary tract function was evaluated using the Pelvic Pain, Urgency and Frequency questionnaire, uroflowmetry and ultrasonography. Their average age was 18 (76% males, 24% females). Most of them lived with their family members. 56% of the subjects were self-supported financially while 35% relied on their families. Use of multiple drugs was reported by 81% of the subjects.

'The normal urinary bladder capacity is 400-500ml. In ketamine users who were taking 3 doses weekly, 4 doses weekly and more than 5 doses weekly, the urinary bladder volume were 203.2ml, 199.6ml and 189.5ml respectively. Small bladder capacity can lead to urinary urgency, frequency, pelvic pain and urinary incontinence symptoms,' said Dr. Mak Siu King, principal investigator and CUHK Honorary Clinical Assistant Professor of Division of Urology.

The study also found that the bladder capacity of young people who had quit taking ketamine for more than one year is larger than those who began to quit (387ml vs 243ml), showing the recovery potential of the urinary bladder. However, there is no guarantee that every damaged urinary bladder can recover completely.

The Pelvic Pain, Urgency and Frequency (PUF) patient symptom scale is a non-invasive diagnostic tool for screening patients with chronic pelvic pain. The PUF patient symptom scale consists of eight self-report items and takes approximately five minutes to complete, helping to evaluate the presence and severity of chronic pelvic pain and lower urinary tract symptoms. When quitting time is categorized into less than three months, three months, six months and one year, the symptoms scores decrease progressively. This reveals that quitting drugs will have a positive impact on relieving the patients' suffering and symptoms of a small diseased urinary bladder.

This is the first-ever report proving the inverse relationship of drug abuse dosage and bladder functions, which can help people to understand the detrimental effects of drug abuse and enhance the motivation of the youth to quit drugs.



(from left) Mr. Keith Ming Chak LUK, Registered Social Worker, Tai Po District Youth Outreaching Social Work Team, Hong Kong Children & Youth Services; Prof. Sidney Kam Hung YIP, Head of Division, Division of Urology, Department of Surgery, CUHK; Dr. Siu King MAK, Honorary Clinical Assistant Professor, Division of Urology, Department of Surgery, CUHK; and Ms. Meow Fung Lin WONG, Registered Social Worker, Youth Outreaching Social Work Team, The Evangelical Lutheran Church of Hong Kong

Presentation in Hong Kong Urological Association annual scientific meeting 2012
A Community study of Uro-Psycho-Physical Changes in Young Adults Using Ketamine

Authors:

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Department of Surgery & Department of Psychiatry, North District Hospital

PURPOSE:

This cross sectional study is to describe the effect of Ketamine abuse on young adults' physical and mental health in different districts of Hong Kong

METHODS:

A mobile clinic run by professional health-care workers from New Territories East Cluster hospitals is established at specific youth centres. Structural questionnaires and assessment tools was used to record physical, mental and urological health status.

RESULTS:

From Sept 2009 to May 2012, 216 cases from 10 districts were recruited by social workers. The mean age is 19.8. They started drug abuse at age of 14.9. 84% take ≥ 3 times/week. In 54 sole ketamine abusers, 53.4% of their urine is positive for other illicit drugs. Average PUF symptoms score is 6.2 and border score is 2.9. 35 (16%) patients have hydronephrosis on USG and 16 (8%) have bilateral hydronephrosis. 20% patients complained of difficulty in urination, 5% for haematuria and 6% for urinary incontinence that requires further workup in urology clinic. Mean HAD score is 14.8 and 13% had history of psychiatric consultation and 15% had suicidal acts.

CONCLUSION:

The prevalence of urological and mental symptoms is lower than previous in-patient studies. We hope early screening can motivate young ketamine abusers to quit.

Education to public

Education DVD on the services for psychotropic substances abusers is designed and produced. It is a visual media to educate the public “how-to-seek-help”. We interviewed various centre-in-charges of organization providing drug treatment and rehabilitation services. The bonus part of the DVD contained a comprehensive list of major organizations providing service in Hong Kong. These DVD will be distributed to schools, local community centres and hospitals.



Flow chart of UROK assessment



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UROK snapshots

14.1.2011 Fanling



Hall overview



Outside view



Reception





BMI / Peak flow station





Urology - ultrasound station



Urology – bladder scan station



Fitness station







Cognitive station



Psychiatry station



25.2.2011 Tai Po

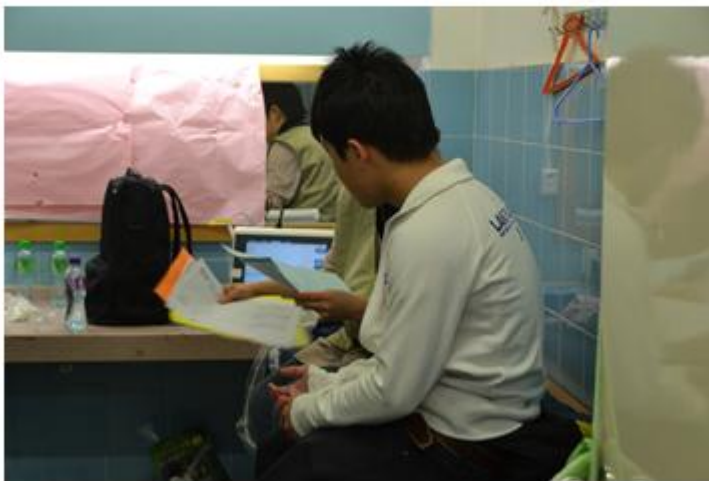


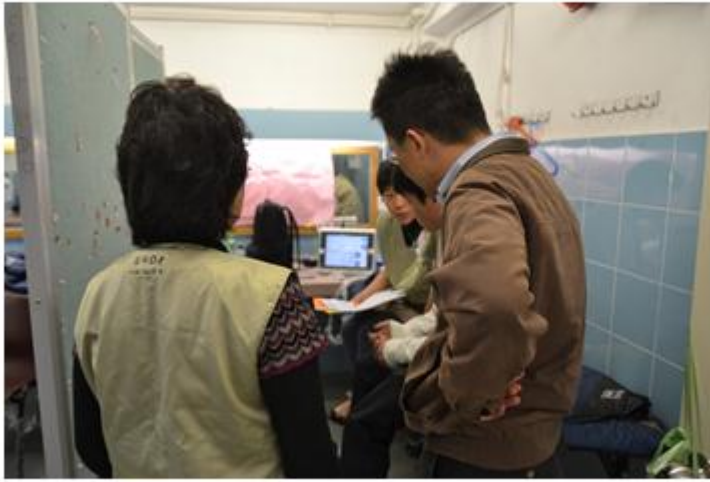


BMI Peak flow station



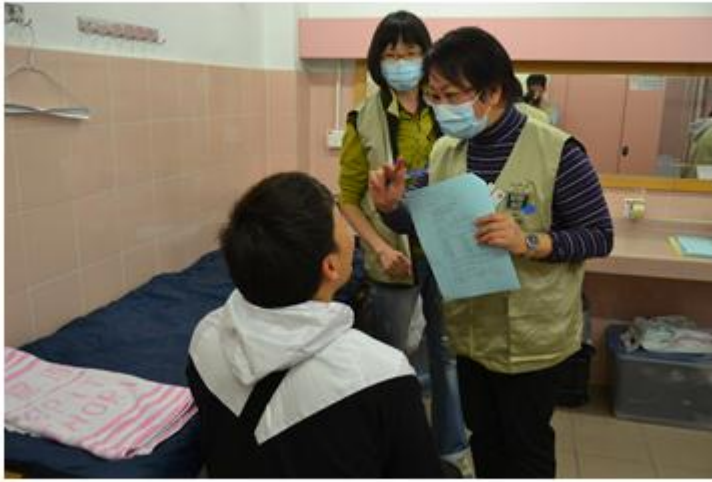
Urology – ultrasound station





Urology – flow rate and bladder scan station





Fitness station







Cognitive station





Psychiatry station





18.3.2011 Tsuen Wan



BMI Peak flow station



Urology – ultrasound station





Urology – flow rate station





Fitness station



Cognitive station



Psychiatry station



6 May 2011



Briefing



Urology nurses



Uroflow rate station



Bladder scan station



Peak flow rate station



Cognitive function station



Discussion of results



Physical function station



Psychiatric assessment station



Urological ultrasound station



13.5.2011 Briefing



Peak flow rate station



Physical function assessment station



Cognitive function assessment station



Psychiatric assessment station



Urine toxicology test kit



Discussion of urine test results



Bladder scan station



Ultrasound station



Discussion of urological results



Group photos





10 June 2011 Global view



Introduction to service



Physical assessment station



Cognitive function assessment station



Uroflow rate station



Ultrasound station



Discussion of urological results



Psychiatric assessment station



8 July 2011 Briefings





Happy faces



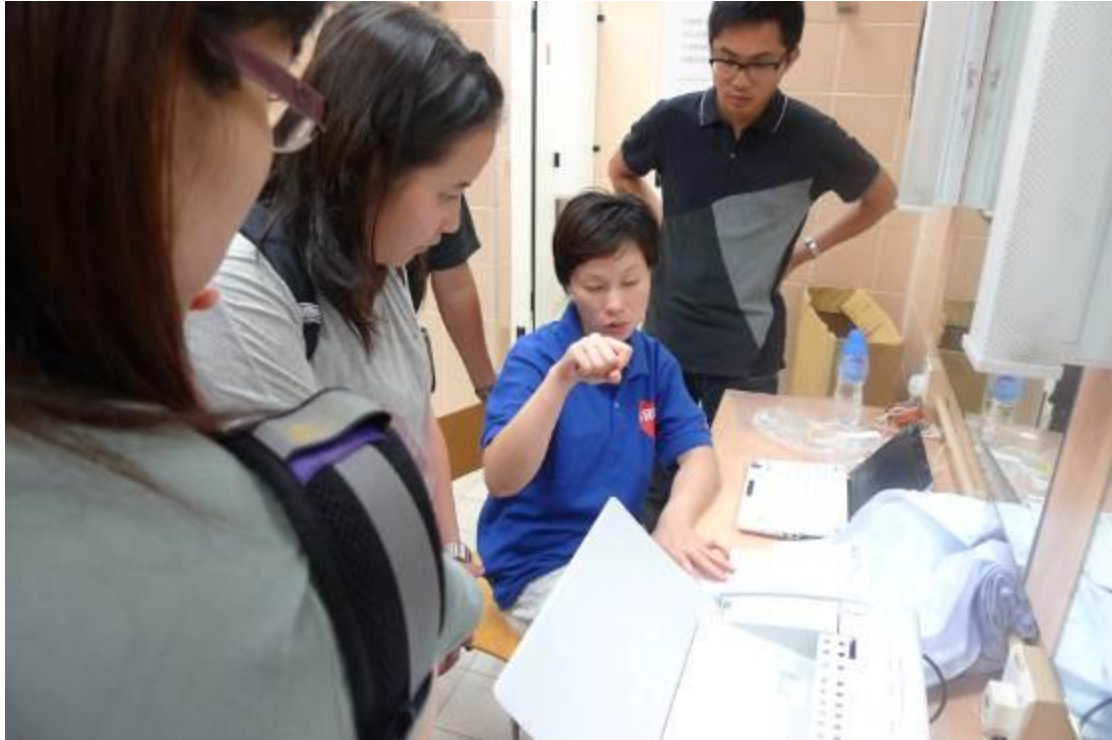
Physical function assessment station



Cognitive function assessment station



Bladder scan station



Ultrasound station



Psychiatric assessment station



23 September 2011 Peak flow rate



Cognitive function assessment



Uroflow rate machine



Urine dip-stix test



Bladder scan



Weight of table salt



Ultrasound view of bladder



Psychiatric assessment



28 October 2011 Peak flow rate station



Physical function assessment station



Ultrasound station



Psychiatric assessment stations



Debriefing



Group photo



2 December 2011 Global view



Briefing to teen



Discussion of urological function



Counselling by psychiatrist



Appendix

Assessment	Details of Assessment
Step Test	Objective: To reflect the function of cardiovascular system
	Equipment: 12-inch high step, stopwatch, metronome
	<p>Procedures:</p> <ol style="list-style-type: none"> 1. Set the metronome at a rate of 30 steps per minute. 2. Therapist calls “GO” and starts the stopwatch simultaneously. 3. The subject steps up and down on the 12-inch high step according to the rate of metronome for a total of 3 minutes (step up with one foot and then the other; step down with one foot followed by the other foot). 4. At the end of 3 minutes, subject remains standing and therapist immediately checks the subject’s heart rate by taking pulse for one minute. 5. Record the heart rate.
Shuttle Run Test	Objective: To reflect the level of agility
	Equipment: stopwatch, tape
	<p>Procedures:</p> <ol style="list-style-type: none"> 1. Mark the starting line and turning line with 10m apart with tape on floor. 2. Therapist calls “GO” and starts the stopwatch simultaneously. 3. Subject starts off from the starting line. 4. Subject sprints to touch the turning line and then returns to the starting line as quickly as possible. 5. Record the finishing time once the subject crosses the finishing line with one attempt only.

Hexagon Test	Objective: To reflect the level of co-ordination and agility
	Equipment: stopwatch, tape
	Procedures: <ol style="list-style-type: none"> 1. Mark a hexagon with 24-inch (or 66cm) each side with tape on floor. 2. Subject stands in the center of the hexagon with facing forward throughout the whole test. 3. Therapist calls "GO" and starts the stopwatch simultaneously. 4. Subject starts double-leg jump from the center of hexagon over each line and then back to the center before another jump in a clockwise direction. 5. Subject completes 18 jumps with 3 circuits and returns back to the center. 6. Record the finishing time for 3 circuits. 7. Take the fastest time out of 3 attempts. Remarks: Start over again if subject jumps the wrong line or lands on the line.
Balance Beam Test	
Balance Beam Test	Objective: To reflect the motor ability of balancing act
	Equipment: balance beam, stopwatch
	Procedures: <ol style="list-style-type: none"> 1. Therapist calls "GO" and starts the stopwatch simultaneously. 2. Subject walks as quickly as possible from one end of the balance beam to the other and then returns to the starting end. 3. Record the best finishing time out of three attempts. Remarks: Start over again if subject off balance from the beam.

U B O K
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