

TABLE OF CONTENTS

	PAGE
ACKNOWLEDGEMENT	iii
ABSTRACT	v
LIST OF TABLES	xii
LIST OF FIGURES	xiii
ABBREVIATIONS	xiv
CHAPTER 1 INTRODUCTION	1
Purpose of the study	4
Hypotheses	4
CHAPTER 2 LITERATURE REVIEW	5
2.1 Lumbopelvic stability control	5
2.1.1 Principle of lumbopelvic stability control	5
2.1.2 Change of lumbopelvic stability control	
in chronic low back pain	9
2.1.3 Assessment of lumbopelvic stability control	14
2.1.4 Principle of lumbopelvic stability training	
in chronic low back pain	15
2.2 Flexibility	17
2.2.1 Definition of flexibility	17
2.2.2 Change of flexibility in chronic low back pain	18

2.2.3	Assessment of flexibility	18
2.2.4	Principle of stretching	19
2.2.5	Effect of Pilates training on flexibility	20
2.3	Pain	21
2.3.1	Possible pain mechanism that associate with motor control of trunk muscle	21
2.3.2	Pain assessment	26
2.4	Stress	27
2.4.1	Stress in chronic low back pain	27
2.4.2	Stress assessment	28
2.4.3	Effect of exercise on stress	28
CHAPTER 3 METHODS		32
3.1	Research design	32
3.2	Subjects	32
3.3	Instrumentation	33
3.4	Procedures	34
3.5	Main outcome assessment	35
3.5.1	The lumbopelvic stability test	35
3.5.2	Flexibility test	36
3.5.3	Pain measurement	37
3.5.4	Stress measurement	38
3.6	Data analysis	38

CHAPTER 4 RELIABILITY STUDY	39
4.1 Reliability of lumbopelvic stability test	39
4.2 Reliability of the flexibility test	40
CHAPTER 5 RESULTS	41
5.1 Descriptive data	41
5.2 Lumbopelvic stability test	42
5.3 Flexibility test	43
5.4 Pain measurement	45
5.5 Stress measurement	47
CHAPTER 6 DISCUSSION	50
6.1 Pilates effect on lumbopelvic stability	50
6.2 Pilates effect on flexibility	54
6.3 Pilates effect on pain	58
6.4 Pilates effect on stress	61
6.5 Limitation	63
CHAPTER 7 CONCLUSION	65
REFERENCES	66
APPENDIX	75
APPENDIX A Visual analogue scale	76
APPENDIX B Stress Inventory questionnaire	77
APPENDIX C Exercise program	79
APPENDIX D Logbook	81
CURRICULUM VITAE	83

LIST OF TABLES

TABLE	PAGE
4.1 Test-retest repeatability of lumbopelvic stability test	39
4.2 Kappa coefficient for intra-examiner reliability test	40
5.1 Demographic data of Pilates and control groups	41
5.2 Comparisons of age and duration of symptom between Pilates and control groups	42
5.3 Chi-square test for lumbopelvic stability score at week 4 and week 8 in Pilates group	43
5.4 The mean values of flexibility	43
5.5 Difference of flexibility between week 0, week 4 and week 8	44
5.6 Significant differences for Tukey's HSD test of flexibility test	44
5.7 Comparison of flexibility between Pilates and control groups	45
5.8 The mean values of average pain intensity level	46
5.9 Difference of pain intensity between week 0, week 4 and week 8	46
5.10 Significant differences for Tukey's HSD test of pain intensity	47
5.11 Comparison of average pain between Pilates and control groups	47
5.12 The mean score of stress level	48
5.13 Difference of stress level between week 0, week 4 and week 8	48
5.14 Wilcoxon signed ranks test for significant differences of stress level in Pilates group	48
5.15 Comparison of stress level between Pilates and control groups	49

LIST OF FIGURES

FIGURE	PAGE
3.1 A stabilizer pressure biofeedback unit	33
3.2 Sit and reach box	34
3.3 Unilateral heel-lift	36
3.4 Sit and reach test	37
5.1 The lumbopelvic stability control of Pilates group	42

ABBREVIATIONS

CLBP	Chronic low back pain
TrA	Transverses abdominis muscle
IAP	Intra-abdominal pressure
CT	Computerized tomography
MRI	Magnetic resonance imaging
PNF	Proprioceptive neuromuscular facilitation
CR	Contract-relax
AC	Agonist contraction
CRAC	Contract-relax-agonist contraction
CNS	Central nervous system
VAS	Visual analogue scale
MSD	Minimum significant difference
ACC	Anterior cingulated cortex
LPS	Lumbopelvic stability